BioCel System

User Guide

Original Instructions

Agilent Technologies

Notices

© Agilent Technologies, Inc. 2010

No part of this manual may be reproduced in any form or by any means (including electronic storage and retrieval or translation into a foreign language) without prior agreement and written consent from Agilent Technologies, Inc. as governed by United States and international copyright laws.

User Guide Part Number

G5500-90011

Edition

Revision 01, August 2010

Contact Information

Agilent Technologies Inc.
Automation Solutions
5301 Stevens Creek Blvd.
Santa Clara, CA 95051
USA

Technical Support: 1.800.979.4811
or +1.408.345.8011
service.automation@agilent.com

Customer Service: 1.866.428.9811
or +1.408.345.8356
orders.automation@agilent.com

European Service: +44 (0)1763850230
euroservice.automation@agilent.com

Documentation feedback:
documentation.automation@agilent.com

Web:
www.agilent.com/lifesciences/automation

Acknowledgements

Microsoft and Windows are registered trademarks of the Microsoft Corporation in the United States and other countries.

Adobe and Acrobat are trademarks of Adobe Systems Incorporated.

Warranty

The material contained in this document is provided "as is," and is subject to being changed, without notice, in future editions. Further, to the maximum extent permitted by applicable law, Agilent disclaims all warranties, either express or implied, with regard to this manual and any information contained herein, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Agilent shall not be liable for errors or for incidental or consequential damages in connection with the furnishing, use, or performance of this document or of any information contained herein. Should Agilent and the user have a separate written agreement with warranty terms covering the material in this document that conflict with these terms, the warranty terms in the separate agreement shall control.

Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

Restricted Rights Legend

If software is for use in the performance of a U.S. Government prime contract or subcontract, Software is delivered and licensed as "Commercial computer software" as defined in DFAR 252.227-7014 (June 1995), or as a "commercial item" as defined in FAR 2.101(a) or as "Restricted computer software" as defined in FAR 52.227-19 (June 1987) or any equivalent agency regulation or contract clause. Use, duplication or disclosure of Software is subject to Agilent Technologies' standard commercial license terms, and non-DOD Departments and Agencies of the U.S. Government will receive no greater than Restricted Rights as defined in FAR 52.227-19(c)(1-2) (June 1987). U.S. Government users will receive no greater than Limited Rights as defined in FAR 52.227-14 (June1987) or DFAR 252.227-7015 (b)(2) (November 1995), as applicable in any technical data.

Safety Notices

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

Contents

Preface vii
About this guide viii
Accessing Automation Solutions user guides x

1. BioCel System overview 1
BioCel System description 2
System specifications 5
Hardware overview 7
Device integration options 23
Software description 24

2. Setting up the BioCel System 27
Setup Workflow 28
Adjusting the keyboard shelf and computer monitor 30
Starting up and shutting down the BioCel System 32
Adding and deleting devices in the software 39

3. Setting up the Direct Drive Robot 45
Setup Workflow 46
Creating and managing Direct Drive Robot profiles 47
Specifying the table dimensions and robot position 53
Planning Direct Drive Robot teachpoints 60
Setting Direct Drive Robot teachpoints 69
Setting teachpoints using a labware 88
Verifying Direct Drive Robot teachpoints 90
Editing existing Direct Drive Robot teachpoints 102
Managing Direct Drive Robot teachpoints 106
Cycling teachpoints 107

4. Setting up the 3-Axis Robot 111
Setup Workflow 112
Creating and managing 3-Axis Robot profiles 113
Setting 3-Axis Robot teachpoints 117
Verifying 3-Axis Robot teachpoints 124
Editing existing 3-Axis Robot teachpoints 127
Renaming 3-Axis Robot teachpoints 128

5. Setting up the KiNEDx Robot . . . 129
Setup Workflow . . . 130
Creating and managing KiNEDx Robot profiles . . . 131
Setting KiNEDx Robot teachpoints . . . 135
Verifying KiNEDx Robot teachpoints and waypoints . . . 143
Editing KiNEDx Robot teachpoints and waypoints . . . 149

6. Preparing for a protocol run . . . 151
Workflow for preparing a protocol run . . . 152
Performing dry runs . . . 153
Reviewing protocols and planning for the run . . . 154
Adding or removing devices mounted on docking tables . . . 155
Checking for system readiness . . . 166
Replacing the waste bin . . . 167
Loading labware in the system . . . 169
Stopping a run in an emergency . . . 171

7. Maintenance and troubleshooting . . . 173
Routine maintenance . . . 174
Recovering from an emergency stop . . . 175
Recovering from a power outage . . . 179
Recovering from servo errors . . . 180
Troubleshooting plate-sensor errors . . . 182
Troubleshooting hardware problems . . . 183
Troubleshooting error messages . . . 189
Reporting problems . . . 203

8. Using diagnostic tools . . . 205
DDR Diagnostics . . . 206
3-Axis Robot Diagnostics . . . 229
KiNEDx Robot Driver Diagnostics . . . 237

A. Additional BioCel System Devices . . . 241
BioCel System additional devices overview . . . 242
Auxiliary barcode reader . . . 244
BioCel I/O Interface . . . 251
Lid Hotel Station . . . 266
Linear Translator . . . 272
Microplate Conveyor . . . 285
Microplate Shuttle and Rotator . . . 301
Orbital Shaking Station . . . 309
Phantom Robot . . . 315
Plate Hotel and Plate Hub Carousel . . . 319
Platepad . . . 329
Vacuum Delid Station . . . 332
Waste bin . . . 337
Weigh Pad . . . 340

B. Block diagrams 347
Power system 348
Air system 351
Vacuum system. 353

C. Quick reference 355
DDR Diagnostics 356
3-Axis Robot Diagnostics 375
KiNEDx Robot Driver Diagnostics. 381

Index 389

Preface

This preface contains the following topics:

- "About this guide" on page viii
- "Accessing Automation Solutions user guides" on page x

About this guide

Who should read this guide

This user guide is for people with the following job roles:

Job role	Responsibilities
Installer	Unpacks, installs, and tests the BioCel System before it is used.
Integrator	Writes software and configures hardware.
Lab manager, administrator, or technician	• Manages the automation system that contains the BioCel System • Develops the applications that are run on the system • Develops training materials and standard operating procedures for operators
Operator	Performs the daily production work on the BioCel System and solves routine problems.

What this guide covers

This guide describes the BioCel System, the operation of the hardware components, and the use of the diagnostics software.

This guide does not provide instructions for the following:

- VWorks software or third-party software
- Agilent Technologies devices, such as the Bravo Automated Liquid Handling Platform, PlateLoc Thermal Microplate Sealer, Microplate Seal Piercer, Microplate Labeler, Vertical Pipetting Station, Microplate Centrifuge, and Labware Stacker.
- Third-party devices

For more information about these topics, see the relevant user guides for these products.

Software version

This guide documents:

- DDR Diagnostics version 1.2.x or later
- 3-Axis Robot Diagnostics version 18.1.2 or later
- KiNEDx Robot Robot Diagnostics version 15.0.0 or later

What's new in this guide

Feature and description	See
The Direct Drive Robot instructions have been updated.	"Setting up the Direct Drive Robot" on page 45 and "Using diagnostic tools" on page 205
Instructions for the Microplate Conveyor are added.	"Microplate Conveyor" on page 285

Related guides

The *BioCel System User Guide* should be used in conjunction with the following user documents:

- *BioCel System Safety Guide*. Describes the potential safety hazards on the BioCel System and how to avoid them.
- *BioCel Environmental-Control System User Guide*. Describes the Environmental-Control System in the BioCel System, the operation of the relevant hardware components, and the use of the iSeries Diagnostic software.
- *VWorks Software Quick Start*. Provides an overview of how to use the VWorks Automation Control software.
- *VWorks Automation Control User Guide*. Explains how to add devices, create protocols, and set task parameters for each device in the system.
- *VWorks Automation Control Setup Guide*. Explains how to define labware, track labware, and manage users.
- *Automation Solutions device user guides*. Explain how to set up and use the Automation Solutions device.
- *Third-party device user documents*. Explain how to set up and use the third-party device.

Related information

For information about...	See...
Accessing related user guides	"Accessing Automation Solutions user guides" on page x
Reporting problems	"Reporting problems" on page 203

Accessing Automation Solutions user guides

About this topic

This topic describes the different formats of Automation Solutions user information and explains how to access the user information.

Where to find user information

The Automation Solutions user information is available in the following locations:

- *Knowledge base*. The help system that contains information about all of the Automation Solutions products is available from the Help menu within the VWorks software.
- *PDF files*. The PDF files of the user guides are installed with the VWorks software and are on the software CD that is supplied with the product. A PDF viewer is required to open a user guide in PDF format. You can download a free PDF viewer from the internet. For information about using PDF documents, see the user documentation for the PDF viewer.
- *Agilent Technologies website*. You can search the online knowledge base or download the latest version of any PDF file from the Agilent Technologies website at www.agilent.com/lifesciences/automation.

Accessing safety information

Safety information for the BioCel System is provided in the *BioCel Automation System Safety Guide*.

Safety information for the Agilent Technologies devices appears in the corresponding device user guide.

You can also search the knowledge base or the PDF files for safety information.

Using the knowledge base

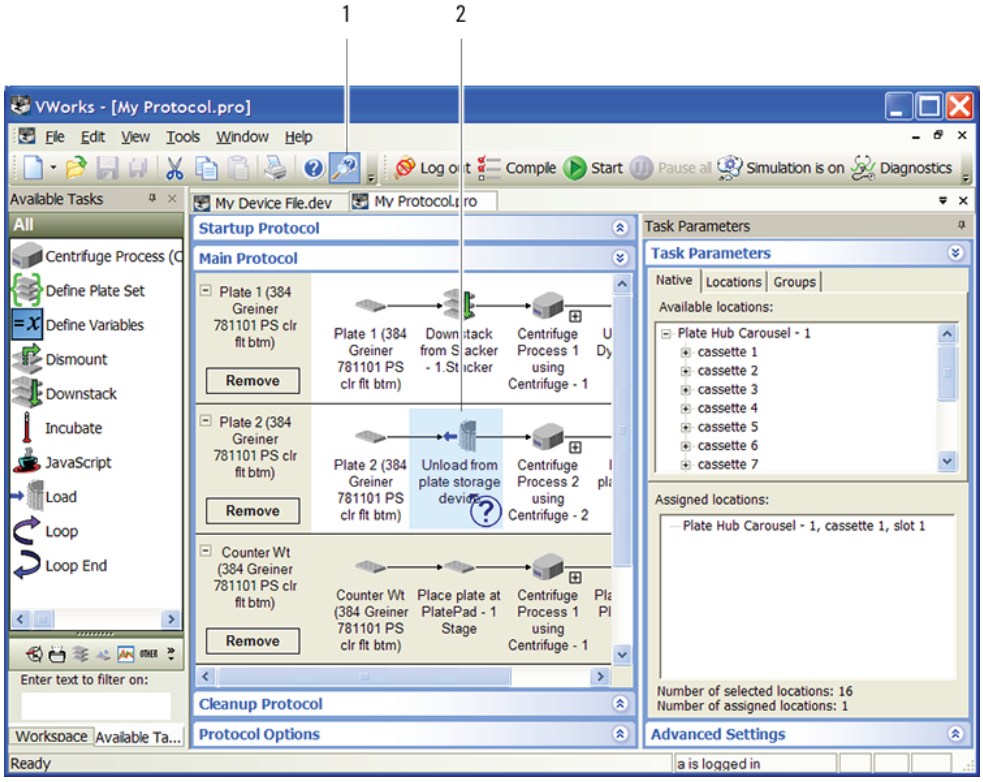
Knowledge base topics are displayed using web browser software such as Microsoft Internet Explorer and Mozilla Firefox.

Note: If you want to use Internet Explorer to display the topics, you might have to allow local files to run active content (scripts and ActiveX controls). To do this, in Internet Explorer, open the **Internet Options** dialog box. Click the **Advanced** tab, locate the **Security** section, and select **Allow active content to run in files on my computer.**

To open the knowledge base, do one of the following:

- From within VWorks software, select **Help** > **Knowledge Base** or press F1.
- From the Windows desktop, select **Start** > **All Programs > Agilent Technologies > VWorks** > **User Guides** > **Knowledge Base.**

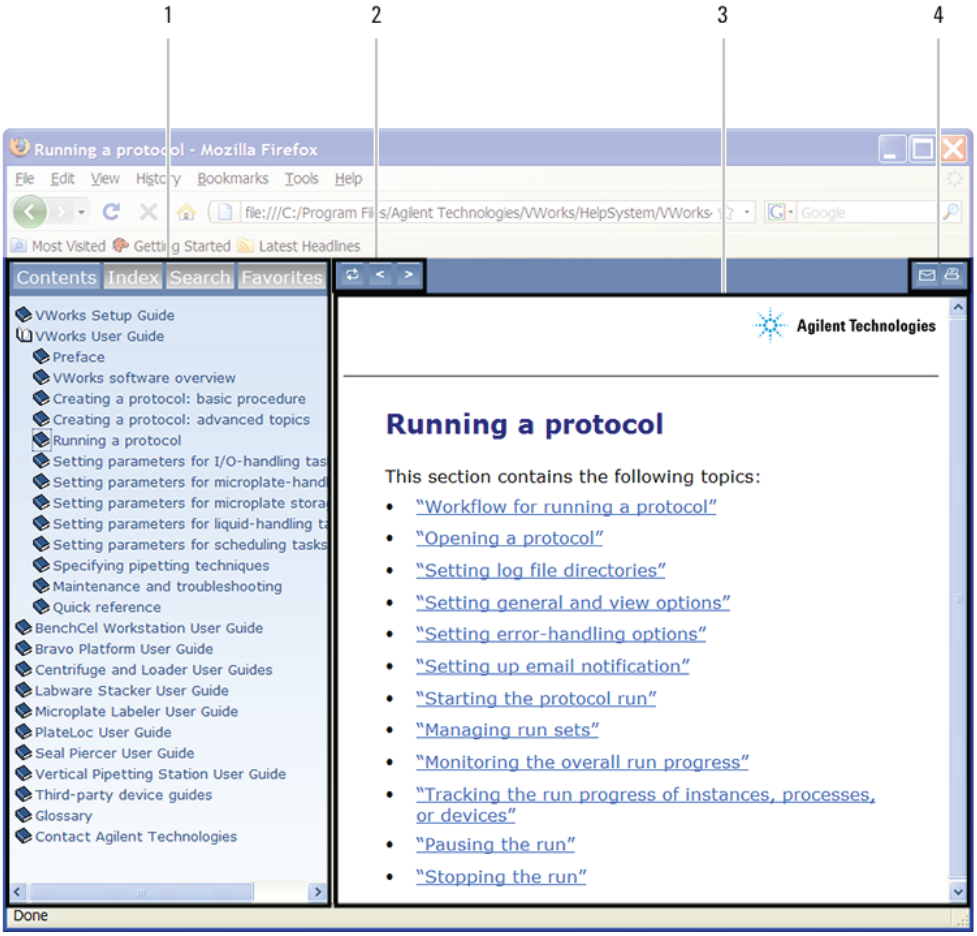
Opening the help topic for an area in the VWorks window



To access the context-sensitive help feature:

1. In the main window of the VWorks software, click the help button . The pointer changes to . Notice that the different icons or areas are highlighted as you move the pointer over them.
2. Click an icon or area of interest. The relevant topic or document opens.

Features in the Knowledge Base window



Item	Feature
1	*Navigation area.* Consists of four tabs: • *Contents.* Lists all the books and the table of contents of the books. • *Index.* Displays the index entries of all of the books. • *Search.* Allows you search the Knowledge Base (all products) using keywords. You can narrow the search by product. • *Favorites.* Contains bookmarks you have created.
2	*Navigation buttons.* Enable you to navigate through the next or previous topics listed in the Contents tab.
3	*Content area.* Displays the selected online help topic.
4	*Toolbar buttons.* Enable you to print the topic or send documentation feedback by email.

Related information

For information about...	See...
Who should read this guide	“About this guide” on page viii
What this guide covers	“About this guide” on page viii

1 BioCel System overview

This chapter contains the following topics:

- "BioCel System description" on page 2
- "System specifications" on page 5
- "Hardware overview" on page 7
- "Device integration options" on page 23
- "Software description" on page 24

BioCel System description

Description

The BioCel System is a laboratory automation platform that:

- Stores labware (microplates, tipboxes, tube racks, and others) that will be processed during a protocol run.
- Moves labware to and from devices for processing. The devices are integrated in the BioCel System and controlled by the VWorks software. For a list of the devices that you can integrate in the system, see "Device integration options" on page 23.

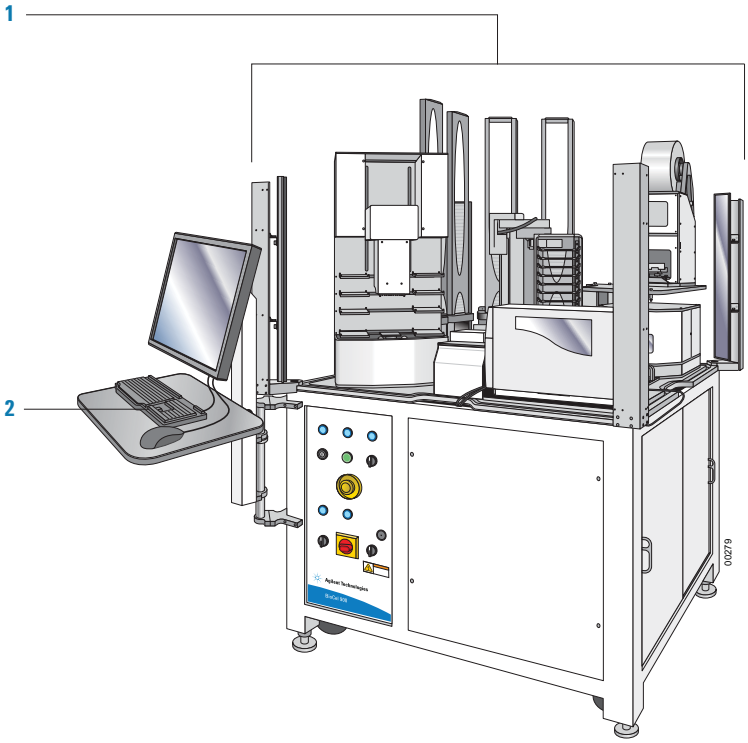
You can use the BioCel System for applications such as compound management, PCR sample preparation, cell-based assays, ADME-Tox assays, high-throughput screening, and so on.

Three models of the BioCel System are available: BioCel 900 System, BioCel 1200 System, and BioCel 1800 System. An environmental-control option can be added in the two larger systems (the BioCel 1200 and 1800 Systems) to create fully contained, contaminant-free environments. See "System specifications" on page 5 for more information about each model.

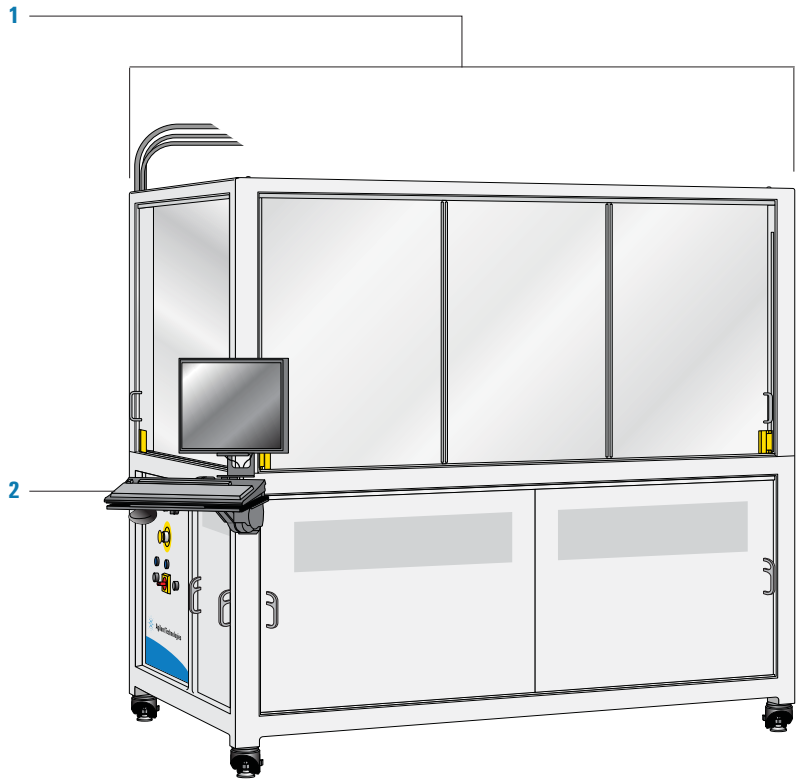
Components

All three BioCel System models consist of the following components: Main body (1), computer (2), and VWorks software (not shown). In a system where multiple BioCel units are connected, only one computer may be provided.

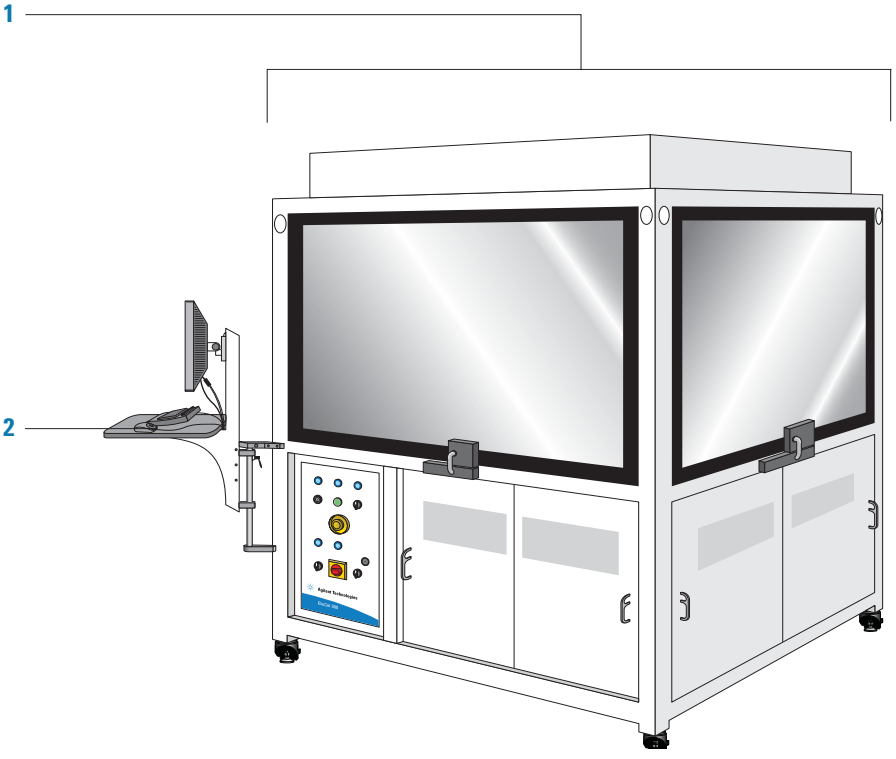
BioCel 900 System



BioCel 1200 System



BioCel 1800 System



Before you operate the system

WARNING **For safe operation, it is imperative that you follow the precautions in the *BioCel System Safety Guide*.**

Related information

For information about...	See...
BioCel System features	"Hardware overview" on page 7
BioCel System specifications	• "System specifications" on page 5 • *BioCel System Site Preparation Guide*
Device integration options	"Device integration options" on page 23
Additional devices	"Additional BioCel System Devices" on page 241
Software that controls the BioCel System	"Software description" on page 24
Safety information	*BioCel System Safety Guide*

System specifications

Physical specifications and ambient environment requirements

For physical dimensions, required clearance, and ambient environment requirements, see the *BioCel System Site Preparation Guide*.

Environmental-control system

An environmental-control option can be added in the BioCel 1200 and 1800 Systems to create fully contained, contaminant-free environments. See the *BioCel Environmental-Control System User Guide* for contained-system requirements.

Electrical requirements

Requirement	US	US/EU/Asia
Voltage	120 V~ single phase	230 V~ 3 wire, 2 pole
Frequency	60 Hz	50/60 Hz
Current	30 A	20 A
Fuses	30 A	20 A
Electrical plug	L5-30	L6-20

Compressed air requirements

The 3-Axis Robot, KiNEDx Robot, and some integrated devices require the use of compressed air.

CAUTION Using oil compressors can cause oil to leak into the system and integrated devices and void your warranty.

Requirement	Value
Quality	Clean, dry (oil content at 0.01 ppm), compressed
Source	One of the following: • Centralized source (house) • Compressed-air cylinders • Portable pumps
Pressure	0.69 MPa (100 psig)
Flow rate	280 Lpm (10 cfm) Minimum
Connection	3/8 in OD poly line

Related information

For information about...	See...
BioCel System description	"BioCel System description" on page 2
Detailed system requirements	*BioCel System Site Preparation Guide*
Hardware features	"Hardware overview" on page 7
Devices that can be integrated in the system	"Device integration options" on page 23
Additional BioCel System devices	"Additional BioCel System Devices" on page 241
Safety information	*BioCel System Safety Guide*

Hardware overview

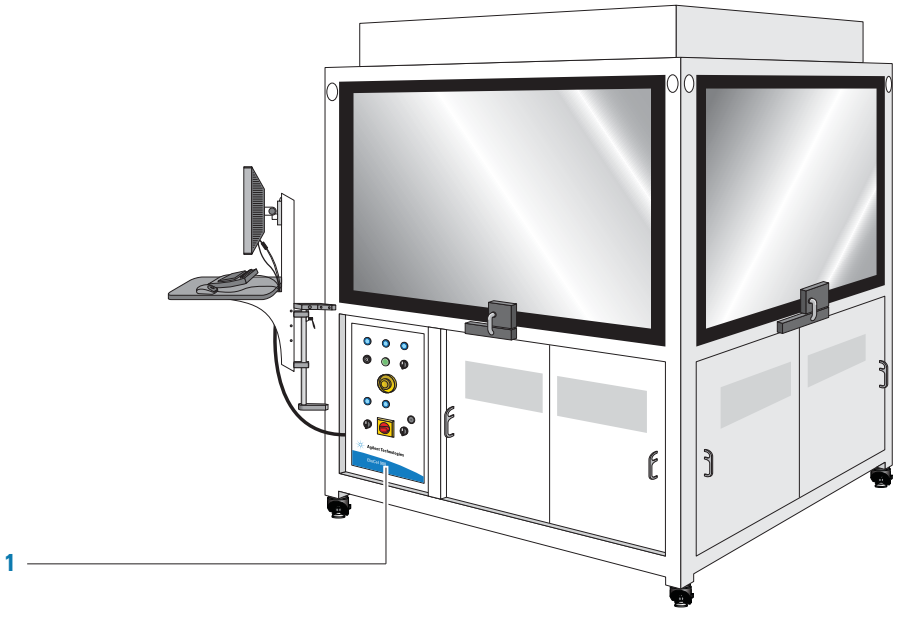
About this topic

This topic describes the following BioCel System hardware features:

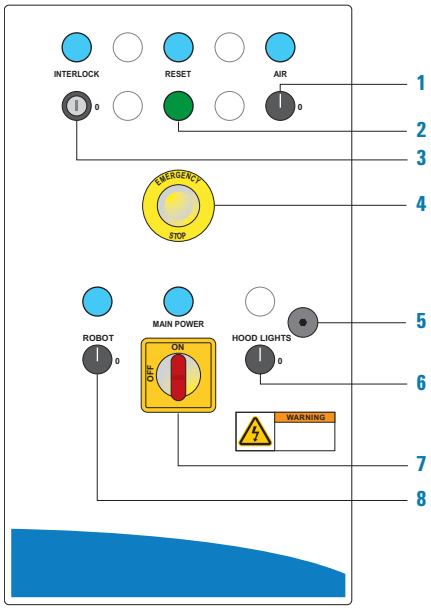
- Power panel
- Environmental Controls panel (in some BioCel 1200 and 1800 Systems)
- Docking tables (optional)
- Safety windows (in BioCel 1200 and 1800 Systems, on docking tables)
- Light Curtains (in some BioCel 900 Systems)
- Air regulation panel
- Power connection
- Robot
- Controlling computer
- Communication hubs
- Status lights (in BioCel 1200 and 1800 Systems)
- Bar code power supply (optional)
- Weigh Pad hub (optional)
- Pump Modules (optional)
- Trash door and chute (optional)
- Direct plumbing (optional)
- UPS (optional in BioCel 900 Systems)

Power panel

The power panel consists of switches for power, air, and safety interlocks. The power panel is located on the lower half of the BioCel System (1).



The following diagram shows the power panel in detail.



Item	Feature	Description
1	Air switch	Turns on and off the air to the system. For instructions, see "Startup procedure" on page 32.
2	Reset button	Resets the emergency stop relay to allow electrical current to flow to the system. Press the Reset button during startup or for emergency stop recovery. For details, see "Starting up and shutting down the BioCel System" on page 32 and "Recovering from an emergency stop" on page 175.
3	Interlock key switch	Turns on and off the safety interlock. **WARNING** **Do not turn off the safety interlock under normal operating conditions.** Designed to protect you from moving-part hazards while the system is in operation, the safety interlock circuit must be closed for the system to operate. If you open an enclosure window, the safety interlock stops the motion of the system robot and devices. Only an administrator who is trained in the safe operation of the system should be permitted to bypass the safety interlock. For detailed instructions, see "Starting up and shutting down the BioCel System" on page 32.

Item	Feature	Description
4	Emergency Stop button	Cuts power and air to the robot motor and integrated devices. The Emergency Stop button is connected to the safety interlock circuit that must be closed for the system to operate. Pressing the Emergency Stop button breaks the safety circuit and disables the robot motors and integrated devices. For more information about stopping the system in an emergency, see the *BioCel System Safety Guide*
5	Power panel door lock	Locks or unlocks the power panel. The system fuses are located inside the power panel. **WARNING Do not defeat the lock and open the door. Only Agilent Technologies personnel should unlock and open the door.**
6	Hood Lights switch	Turns on the lights in the hood. The switch is only used in systems with hood lights.
7	Main Power switch	Turns on and off the BioCel System. For detailed instructions, see "Starting up and shutting down the BioCel System" on page 32.
8	Robot switch	Turns on and off the system robot. For detailed instructions, see "Starting up and shutting down the BioCel System" on page 32.

Environmental Controls panel

The Environmental Controls panel consists of switches for power and optional inert gas, and is located next to the power panel. Installed in some BioCel 1200 and 1800 Systems, the panel is a part of the BioCel Environmental-Control System. For information, see the *BioCel Environmental-Control System User Guide*.

Docking tables (optional)

If you have applications that require periodic or frequent addition or removal of a device in the BioCel System, you can mount the device on a docking table. The docking table sits on wheels so that you can easily move it.

The table must be docked adjacent to the BioCel System to prevent movement during a protocol run. When you no longer need the device, you can undock and move the table.

For instructions on how to dock or undock a table, see "Adding or removing devices mounted on docking tables" on page 155.

Safety windows

Sliding windows or enclosure overhead windows

Depending on the configuration, either sliding windows or enclosure overhead windows are installed in the BioCel 1200 or 1800 System. Because enclosure overhead doors are designed to be air-tight, they are installed in systems that require environmental control.

The sliding windows and enclosure overhead windows are part of the safety interlock circuit that must be closed for the BioCel 1200 or 1800 System to operate. Designed to protect you from moving-part hazards while the system is in operation, opening a window during a run will break the safety circuit and instantly stop the motion of the BioCel System and device robots.

IMPORTANT You cannot open windows of inert environment systems until the gas is purged.

For detailed safety information, see the *BioCel System Safety Guide*.

Removable windows on docking tables

Some docking tables have protective windows that are connected to the safety interlock circuit and function like enclosure windows. Designed to protect you from moving-part hazards while the system is in operation, removing a window during a run will break the safety circuit and instantly stop the motion of the BioCel System and device robots.

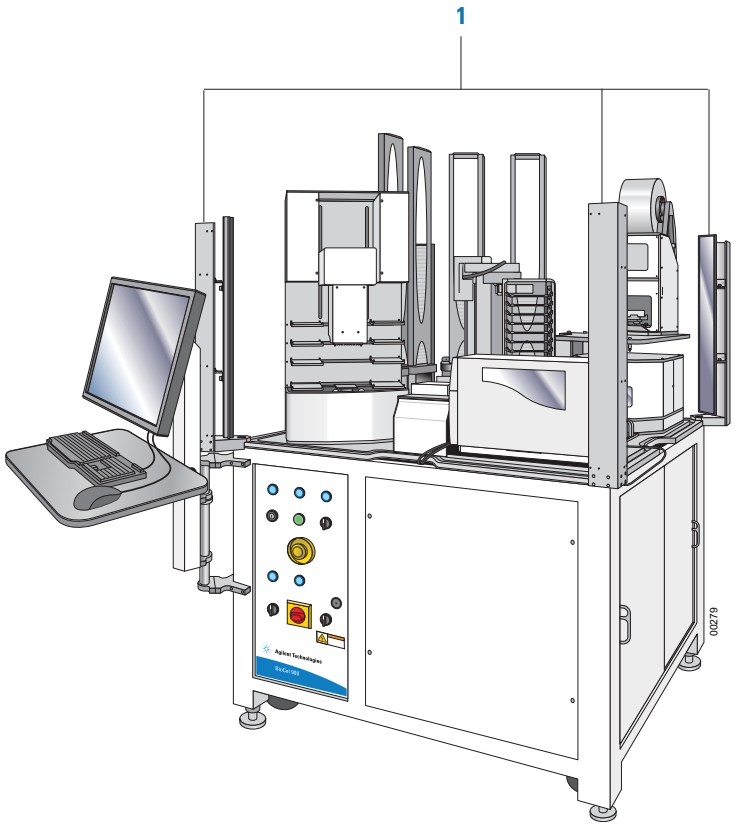
Instead of connecting to the safety interlock circuit, some protective windows have locks to prevent operators from entering the system while the system is in motion. The protective window should be locked during system operation.

For detailed safety information, see the *BioCel System Safety Guide*.

Light Curtains

Light Curtains are part of the safety interlock circuit that must be closed for the BioCel 900 System to operate. Designed to protect you from moving-part hazards while the system is in operation, the Light Curtains detect interruptions in the light beams from the posts, break the safety circuit, and pause the protocol run.

A Light Curtain post is located at each corner of the BioCel 900 System (**1**).

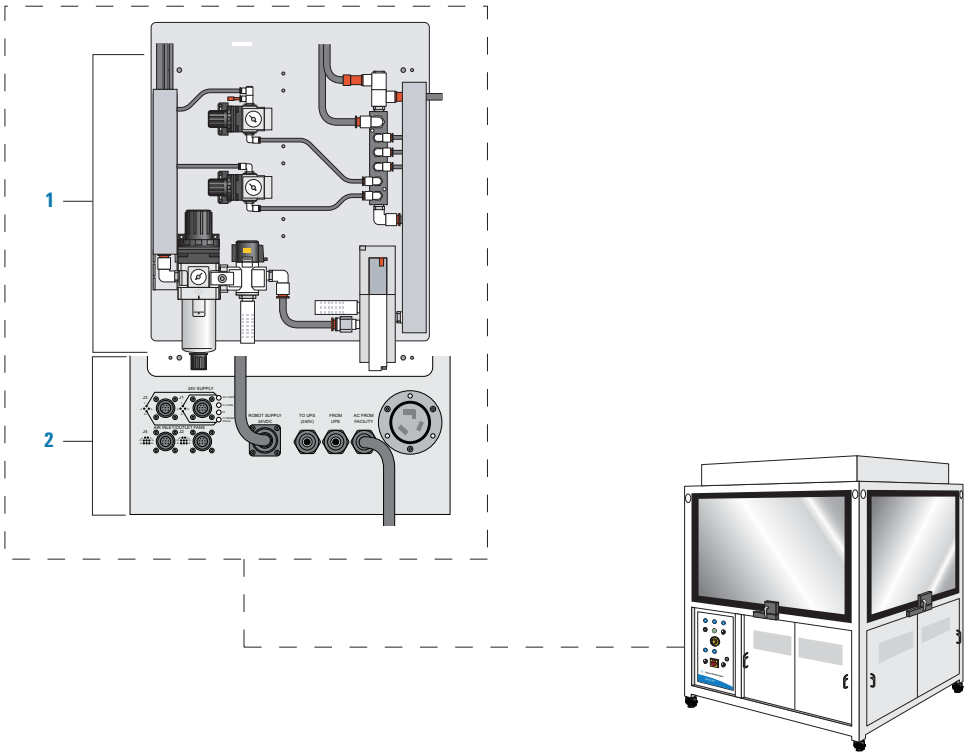


For detailed safety information, see the *BioCel System Safety Guide*.

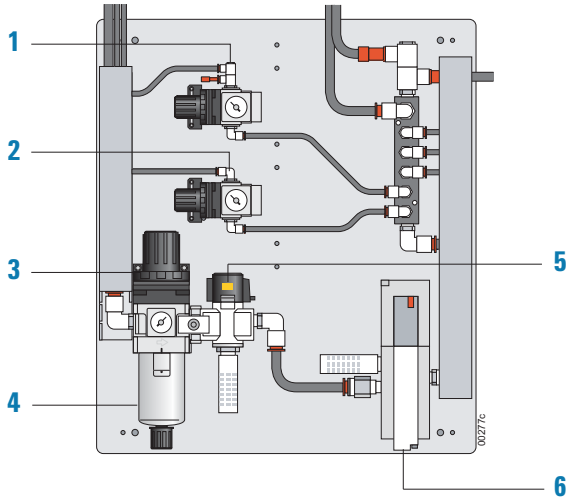
Air regulation panel

The air regulation panel (1) contains air supply connections, regulators, and filter. The panel is located behind the power panel, above the power connections (2). To access the panel, open the cabinet door nearest the power panel.

Note: Depending on the options you installed, the air regulation panel might look differently than shown in the diagrams.



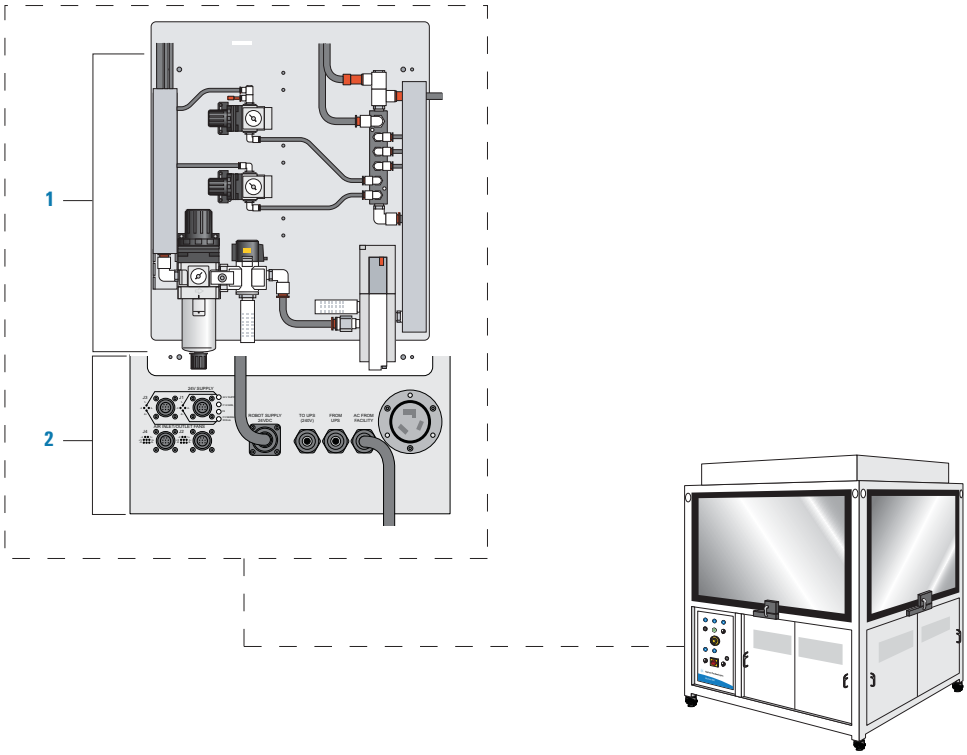
The following diagram shows the components that control the system air supply in detail.



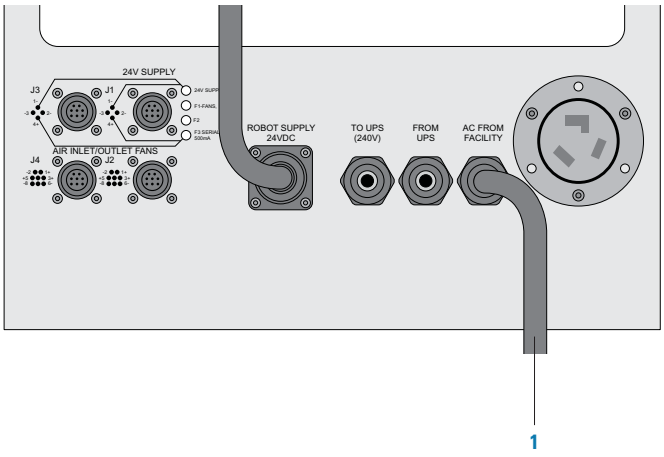
Item	Feature	Description
1	Robot gripper air pressure regulator	Controls how firmly the robot grips a microplate. This feature is available only in systems that have the 3-Axis Robot or KiNEDx Robot.
2	Delidder air pressure regulator (optional)	Controls the air pressure to the vacuum-based lid remover.
3	System air pressure regulator	Controls the air pressure to the entire BioCel System. This component is only available in systems that have the 3-Axis Robot, KiNEDx Robot, or devices that require air supply.
4	Air filter	Filters the air supply to the system and traps oil or liquid in the supply line. This feature is only used in systems that have the 3-Axis Robot, KiNEDx Robot, or devices that require air supply.
5	Air supply shutoff valve	Turns on or off the air supply to the system. This feature is only available in systems that have the 3-Axis Robot, KiNEDx Robot, or devices that require air supply. Use the valve to turn off the air supply only if the Air switch on the power panel is not working, or if the air is leaking in the system. *Note:* A loud noise can be heard when you shut off the valve and residual air is released.
6	Air valve actuator	Turns on or shuts off the air supply to the system. The actuator is controlled by the Air switch on the power panel. Pressing the Emergency Stop button on the power panel turns off the actuator, which turns off the air supply. This feature is only used in systems that have the 3-Axis Robot, KiNEDx Robot, or devices that require air supply.

Power connection

The power connections (2) are located behind the power panel, below the air regulation panel (1). To access the connections, open the cabinet door nearest the power panel.



The following diagram shows the power connections. The power source connects to the BioCel System as shown (1).



External utilities connections

Depending on the configuration, the connections to external utilities enter the system through either the main frame posts or at the top of the system. If the system has direct plumbing instead of using reservoirs and waste containers, the water lines might enter through the frame corners.

Robot

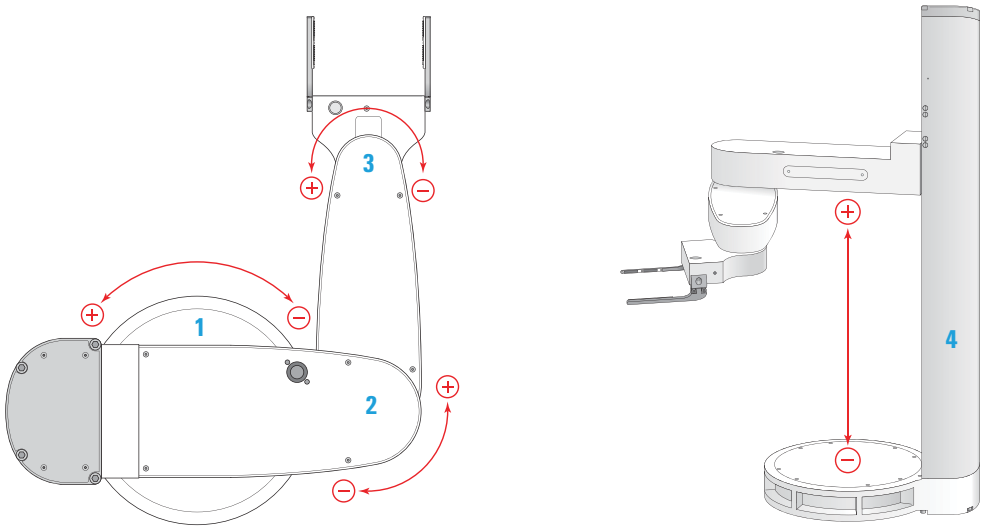
The BioCel System uses one of the following robots:

- Direct Drive Robot
- 3-Axis Robot
- KiNEDx Robot
- Staubli Robot

Direct Drive Robot

The Direct Drive Robot is available in all three models of the BioCel System. It has four axes of motion and is able to grip labware in both the landscape and portrait orientations.

Figure Direct Drive Robot axes of movements (top view and side view)



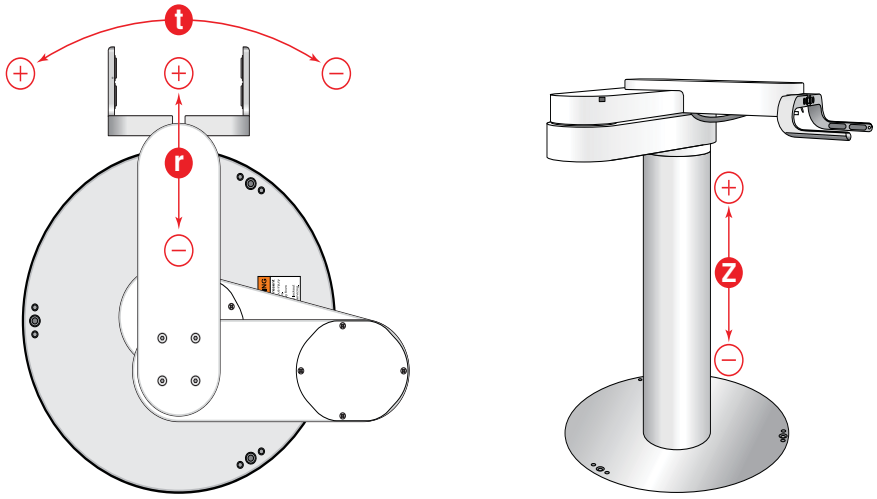
Item	Axis	Description of robot movement
1	Waist	Robot arm rotates infinitely about the waist.
2	Elbow	Robot forearm rotates infinitely about the elbow.
3	Wrist	Robot hand rotates infinitely about the wrist.
4	Mast	Robot arm moves up and down along the mast.

3-Axis Robot

The 3-Axis Robot is available in the BioCel 1200 and BioCel 1800 Systems, and is an option in the BioCel 900 System. It is able to move along three axes: *r*, *z*, and *theta* (or *t*).

Note: All movements are measured from the robot home position.

Figure The 3-Axis Robot axes of movement (top view and side view).



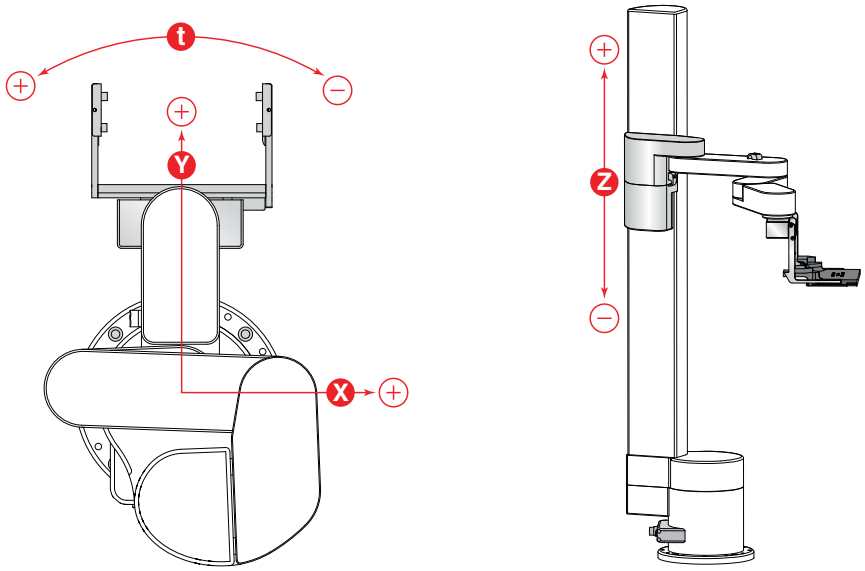
KiNEDx Robot

The KiNEDx Robot is in most BioCel 900 Systems and is able to move along four axes: *x*, *y*, *z*, and *theta* (or *t*).

Notes:

- The origin of the *x*- and *y*-axes is at the center of the robot base.
- The grippers rotate about the wrist joint along the *theta*-axis (or *t*-axis).
- All movements are measured from the robot home position.

Figure The KiNEDx Robot axes of motion (top view and side view).



Staubli Robot

For information about the Staubli Robot, see the *Staubli TX60 Device Driver User Guide*.

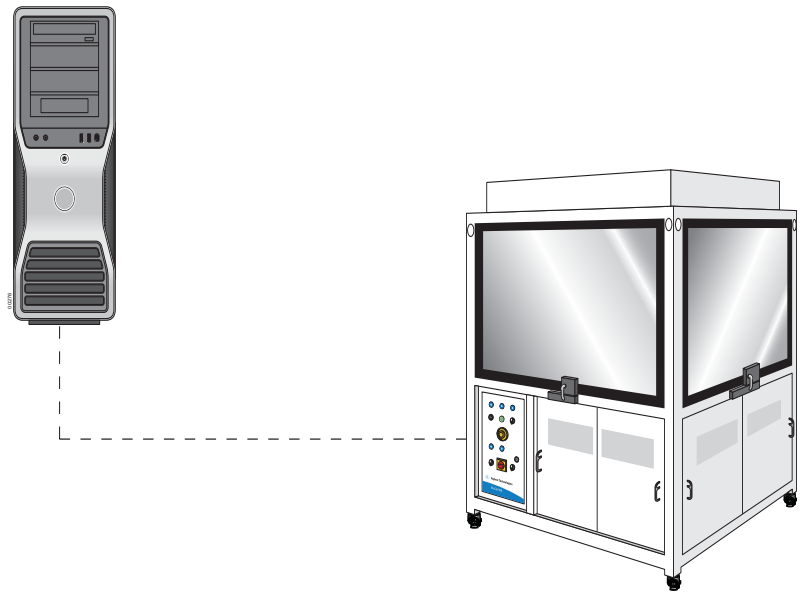
Controlling computer

The supplied computer:

- Runs the VWorks software and controls the BioCel System and integrated devices.
- Receives barcode-labeling instructions.
- Stores data collected by microplate readers.

  Note: Some microplate readers have their own computer for storing data.
- Stores log files.
- Communicates with other computers on your organization's network for file exchanges and email access.

The computer is located inside the BioCel System cabinet. To access the computer, open the cabinet door nearest the power panel.



Network cards

The supplied computer has two Ethernet ports. One of the Ethernet ports connects to the Ethernet switch, the second Ethernet port connects to your organization's wide area network (WAN).

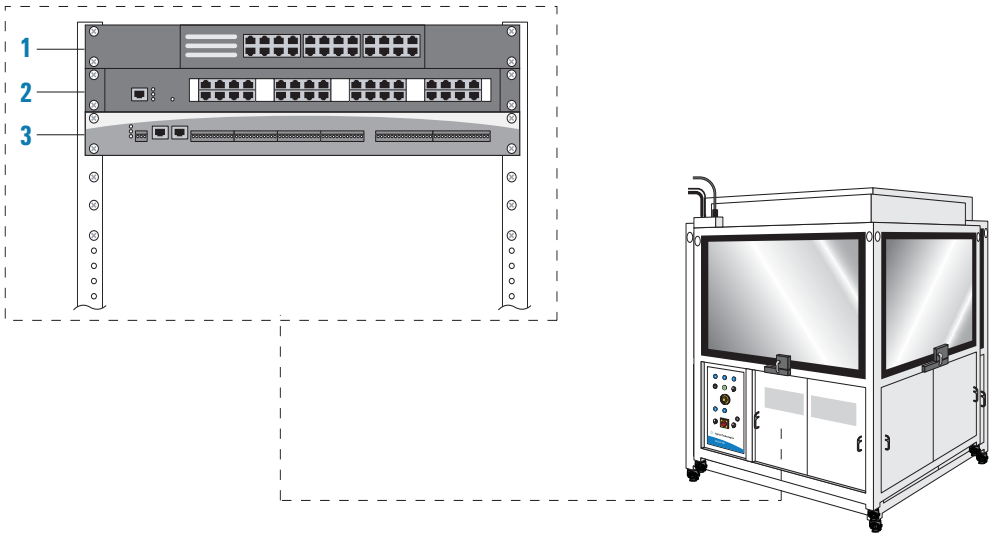
For information about the network requirements and setup, see the *VWorks Automation Control Setup Guide*.

Computer monitor

A computer monitor is supplied with the BioCel System and it is mounted on one of the corners. If your BioCel System has a device that includes its own computer, you can connect that computer to the supplied BioCel System computer monitor. You can switch the monitor display between the two computers.

Communication hubs

The communication hubs are located inside the BioCel System cabinet. To access the hubs, open the cabinet door nearest the power panel.



Item	Hub	Description
1	Ethernet switch	Connects the controlling computer to the serial hub, the Bio I/O console, various devices in the system that use Ethernet communication. The switch can also be used to connect the controlling computer to the local area (system) network. *Note:* To connect the controlling computer to a wide area network, use the built-in network card in the controlling computer.
2	Serial hub	Connects the controlling computer (through the Ethernet switch) to the various devices in the system that use serial communication.
3	BioCel I/O Interface console	Transmits signals from various sensors to the computer. In response to the signals, the computer turns on or off status lights, and opens or closes optional doors. The console also provides 24 V power to some devices such as the Lid Hotel Station and Vacuum Delid Station.

Status lights

Status lights enable you to monitor the current status of the BioCel System from a distance. The signals monitored depends on the configuration in the BioCel I/O Interface.

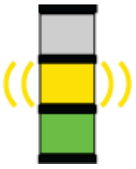
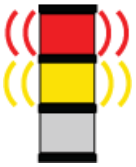
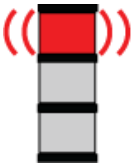
Two types of status lights are available:

- *Stack lights*. Multi-color status lights are available for the BioCel 1800 System and are optional for the BioCel 1200 System.
- *Blue lights*. Blue status lights are available on the frames of the BioCel 1800 System.

Note: You can monitor the status of a BioCel 900 System in the VWorks software.

Stack lights

A single red, yellow, and green light fixture is located above one of the frame posts in the BioCel 1200 System and BioCel 1800 System. Different light patterns indicate different conditions.

Light pattern		Status
	Red = Off Yellow = Off Green = On	System is idle or running in error-free mode. The interlock is on.
	Red = Off Yellow = Flashing Green = On	System is idle or running in error-free mode. Interlock is off.
	Red = Flashing Yellow = Flashing Green = Off	System has encountered a run error, the operator clicked the Pause button in the software, or one of the system doors is open. Interlock is off.
	Red = Flashing Yellow = Off Green = Off	System has encountered a run error, the operator clicked the Pause button in the software, or one of the system doors is open. Interlock is on.
	Red = Off Yellow = Off Green = Off	VWorks software is not running. If the software is running, the BioCel I/O Interface is not initialized or is disconnected.

For information about the safety interlock, see "Power panel" on page 7.

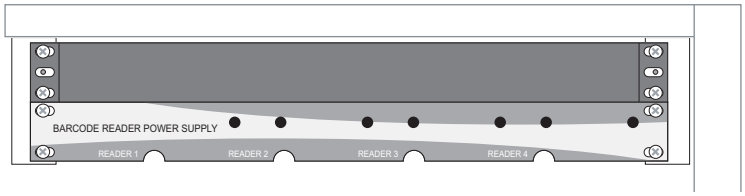
Blue status lights

A blue status light is located on each BioCel 1800 System frame post. Different light patterns indicate different system conditions.

Light pattern	Status
All on solid	Run progressing normally
All off	Not currently running
All blinking simultaneously	Run error
One light on each post blinking twice, followed by the other light on each post blinking twice	Run progressing normally but with interlock bypass in use
All blinking in circular pattern	Run complete

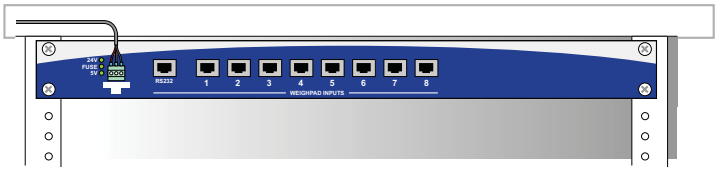
Bar code power supply (optional)

The barcode power supply is an optional component that supplies power to auxiliary barcode readers integrated in the system. The barcode power supply is located under the BioCel System table. Depending on the system configuration, the barcode power supply is sometimes mounted on the rack that holds the communication hubs.



Weigh Pad hub (optional)

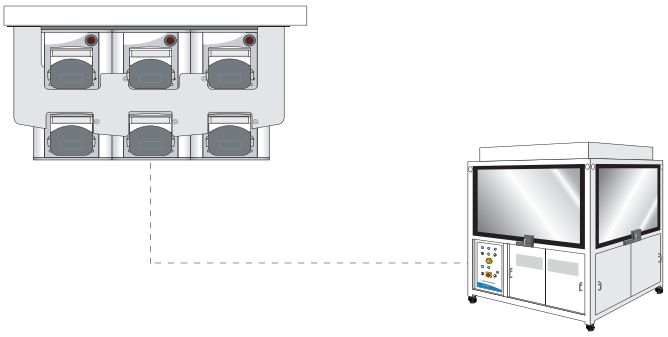
The Weigh Pad hub is a central electrical and communication connection point for one or more Weigh Pads and the controlling computer. The Weigh Pad hub is located under the BioCel System table. Depending on the system configuration, the Weigh Pad hub is sometimes mounted on the rack that holds the communication hubs.



Pump Modules (optional)

The Pump Module is a device that transfers fluids into and waste away from the Vertical Pipetting Station and Bravo accessories. The Pump Module contains two peristaltic pumps that are controlled using the VWorks software.

The Pump Modules are mounted under the BioCel System table. To access the Pump Modules, open the cabinet door.



Trash door and chute (optional)

The trash door is located immediately below the BioCel System table surface. The door slides open to allow used pipette tips or labware to fall into the waste bin under the table.

Direct plumbing (optional)

Instead of using reservoirs and waste containers, the BioCel System can have direct plumbing from an external water source. Depending on the system configuration, the plumbing lines can enter the system at different locations.

UPS

The UPS is included in the BioCel 1200 System and the BioCel 1800 System, but is an optional component in the BioCel 900 System. It is located inside the BioCel System cabinet. To access the UPS, open the cabinet door nearest the power panel.

The UPS:

- Is a backup power source for the BioCel System.
- Provides up to 15 minutes of power to the system during a power outage.

Note: Depending on the system configuration, the UPS might allow the system to run longer than 15 minutes during a power outage.

Related information

For information about...	See...
BioCel System description	"BioCel System description" on page 2
Additional BioCel System devices	"Additional BioCel System Devices" on page 241
BioCel System software	"Software description" on page 24
BioCel System specifications	"System specifications" on page 5
Safety information	*BioCel System Safety Guide*

Device integration options

About devices

Devices are individual pieces of equipment that are integrated in the BioCel System. Devices can store or process labware.

Agilent Technologies devices

Agilent Technologies devices that can be integrated in a BioCel System include:

- Bravo Automated Liquid Handling Platform
- PlateLoc Thermal Microplate Sealer
- Labware Stacker
- Microplate Centrifuge
- Microplate Seal Piercer
- Microplate Labeler
- Vertical Pipetting Station

For details on how to set up these devices, see the user guide for the device.

Additional devices can be integrated in the BioCel System. For the list of additional devices, see "Additional BioCel System Devices" on page 241.

Third-party devices

Many third-party devices can be integrated in a BioCel System. For a comprehensive list, contact Automation Solutions Customer Service.

If you would like to add other devices to the BioCel System, contact Automation Solutions Customer Service.

Related information

For information about...	See...
BioCel System description	"BioCel System description" on page 2
BioCel System hardware features	"Hardware overview" on page 7
Additional BioCel System devices	"Additional BioCel System Devices" on page 241
BioCel System software	"Software description" on page 24
BioCel System specifications	"System specifications" on page 5
Safety information	*BioCel System Safety Guide*

Software description

About this topic

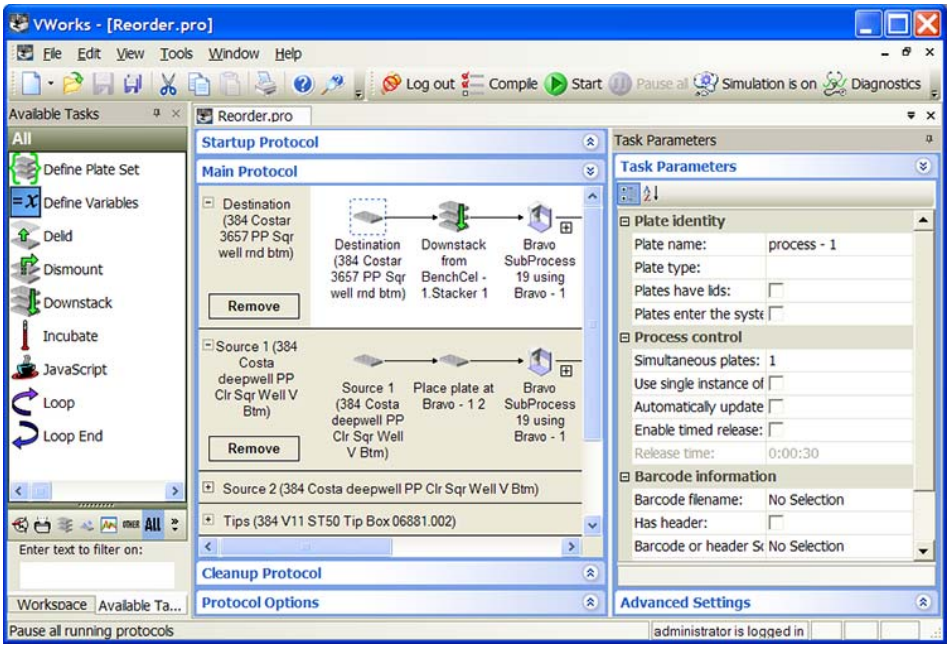
You use the VWorks software and device diagnostics software to set up, run, and troubleshoot the BioCel System. This topic describes the VWorks software and robot diagnostics software. For information about the diagnostics software of an integrated device, see the device user guide.

VWorks software

The VWorks software allows you to:

- *Set up the BioCel System.* During setup, you need to create a device file for the BioCel System robot and integrated devices. For setup information, see "Setup Workflow" on page 28.
- *Set up user accounts and privileges.* You can set up different user accounts to enforce access policies. For instructions, see the *VWorks Automation Control Setup Guide*.
- *Define labware.* Labware definitions describe the labware you will use during protocol runs. For instructions, see the *VWorks Automation Control Setup Guide*.
- *Create protocols.* Protocols determine the sequence of tasks you want to automate in a run. For example, you can use a protocol to apply barcode labels to 100 microplates. For protocol-writing instructions, see the *VWorks Automation Control User Guide*.
- *Run, pause, monitor, and stop protocols.* You can start, pause, monitor, and stop a protocol run from the controlling computer.

For a full description and instructions on how to use the VWorks software, see the *VWorks Automation Control User Guide*.



Robot diagnostics software

Accessed through the VWorks software, the robot diagnostics software allows you to:

- *Create and manage profiles*. Robot profile allows you to set up communication between the robot and the controlling computer. You create the profile when you set up the system. For setup information, see "Setup Workflow" on page 28.
- *Set and edit teachpoints*. Teachpoints are locations that the BioCel System robot will go to and from during a protocol run. You set teachpoints when you set up the BioCel System. You can also edit the teachpoints to correct or fine-tune the original teachpoints. For teachpoint setup and editing information, see "Setup Workflow" on page 28.
- *Diagnose problems*. Moving and adjusting individual hardware components allow you to diagnose and troubleshoot problems. For information on diagnosing and troubleshooting problems, see "Using diagnostic tools" on page 205.

The diagnostics software you use depends on the robot installed in the system.

- If the BioCel System has the Direct Drive Robot, see the instructions for "DDR Diagnostics" on page 206.
- If the BioCel System has the 3-Axis Robot, see the instructions for "3-Axis Robot Diagnostics" on page 229.
- If the BioCel System has the KiNEDx Robot, see the instructions for "KiNEDx Robot Driver Diagnostics" on page 237.

Related information

For information about...	See...
VWorks software instructions	*VWorks Automation Control User Guide*
BioCel System description	"BioCel System description" on page 2
BioCel System specifications	"System specifications" on page 5
BioCel System hardware features	"Hardware overview" on page 7
Additional BioCel System devices	"Additional BioCel System Devices" on page 241
Devices that can be integrated in the system	"Device integration options" on page 23
Safety information	*BioCel System Safety Guide*

2
Setting up the BioCel System

This chapter explains how to set up the BioCel System for operation. This chapter contains the following topics:

- "Setup Workflow" on page 28
- "Adjusting the keyboard shelf and computer monitor" on page 30
- "Starting up and shutting down the BioCel System" on page 32
- "Adding and deleting devices in the software" on page 39

Setup Workflow

About this topic

This topic presents the workflow for setting up the BioCel System for operation.

Workflow

The following table presents the steps for setting up the BioCel System. After setting up the BioCel System for the first time, you will not likely change any of the settings in the procedure unless you add a device, replace a device, or move the BioCel System.

IMPORTANT Before proceeding to step 5 (setting teachpoints), you should already have definitions for the labware you want to use. Although you can define labware at any time, Agilent Technologies recommends that you define labware before setting up the BioCel System. For instructions on how to define labware, see the *VWorks Automation Control Setup Guide*.

Step	For this task...	See...
1	Adjust the keyboard shelf.	"Adjusting the keyboard shelf and computer monitor" on page 30
2	Start up the BioCel System.	"Starting up and shutting down the BioCel System" on page 32
3	Create a device file and add devices in the software.	"Adding and deleting devices in the software" on page 39 or device user guide
4	Create a profile.	One of the following: • "Creating and managing Direct Drive Robot profiles" on page 47 • "Creating and managing 3-Axis Robot profiles" on page 113 • "Creating and managing KiNEDx Robot profiles" on page 131 • Device user guide • Third-party device driver user guide

Step	For this task...	See...
5	Set and edit teachpoints for integrated devices.	One of the following: • "Setting Direct Drive Robot teachpoints" on page 69 • "Setting 3-Axis Robot teachpoints" on page 117 • "Setting KiNEDx Robot teachpoints" on page 135 • Device user guide • Third-party device driver user guide
6	Write protocols.	*VWorks Automation Control User Guide*

Related information

For information about...	See...
Operating the BioCel System	"Checking for system readiness" on page 166
Troubleshooting problems	"Maintenance and troubleshooting" on page 173

Adjusting the keyboard shelf and computer monitor

About this topic

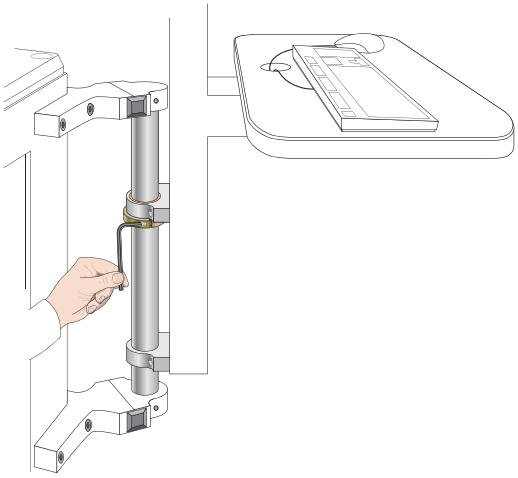
This topic explains how to change the height of the computer keyboard shelf, change the tilt angle of the computer monitor, and switch monitor display between two computers.

Adjusting the shelf height

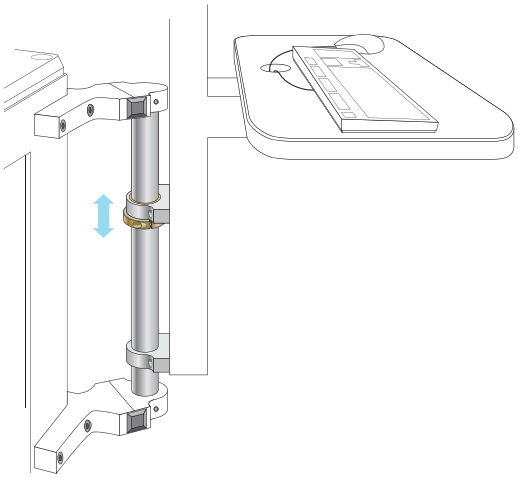
To adjust the keyboard shelf height:

1 Swivel the keyboard shelf toward the front (power-panel side) of the BioCel System.

2 Using the supplied hex wrench (attached to the back of the keyboard shelf frame), loosen the screw on the height-adjusting ring.



3 Move the keyboard shelf to the desired height.

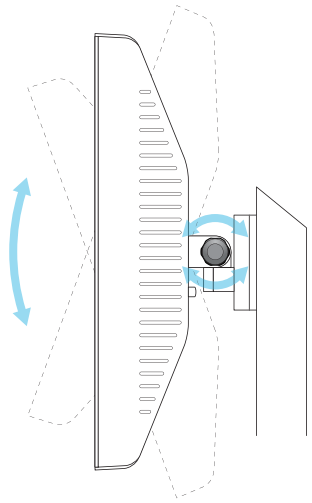


4 Tighten the screw on the height-adjusting ring to set the height.

Adjusting monitor tilt angle

To adjust the computer monitor tilt angle:

1 Turn the black knob on the back of the computer monitor.



2 Tilt the computer monitor to the desired angle.

3 Tighten the knob on the back of the computer monitor.

Switching monitor display between two computers

If your BioCel System has a device that includes its own computer, you can connect that computer to the supplied BioCel System computer monitor. You can switch the monitor display between the two computers. To switch monitor display between the two computers, rapidly press the SCROLL LOCK key on the keyboard twice.

Related information

For information about...	See...
BioCel System computer	"Controlling computer" on page 17
Setup workflow	"Setup Workflow" on page 28
Safety information	*BioCel System Safety Guide*

Starting up and shutting down the BioCel System

About this topic

This topic explains how to start up and shutdown the BioCel System.

Startup procedure

When you start up the system you need to:

1. Turn on the power and the robot.
2. Turn on the computer and devices.
3. Turn on the interlock, air, and optional gases and devices.

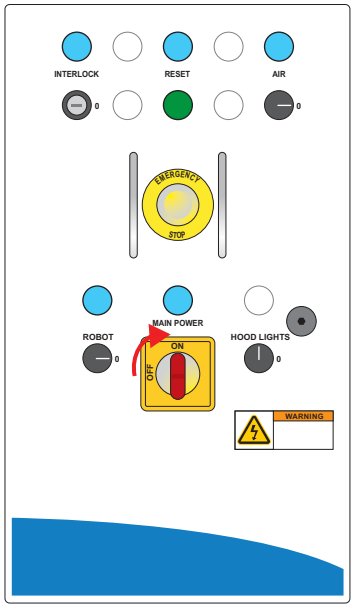
Before you turn on the system:

1. Make sure the main power line, air line, vacuum line (optional) and Ethernet cable (optional) are connected.
2. Make sure external drains and water lines are attached if your BioCel System uses them. Make sure the hoses are not kinked and that the hoses go through the appropriate pumps.
3. Make sure that any autofilling reservoirs are connected.

To turn on the power and robot:

1. Turn on the power. To do this, on the power panel, turn the **MAIN POWER** switch clockwise to the **ON** position.

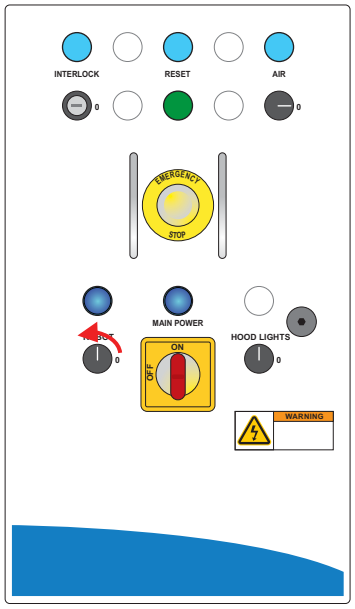
   Note: The indicator light above the Main Power switch does not turn on when you turn on the power.



2 If you have one or more UPS units, slide open the cabinet door nearest the power panel, and then turn on the UPS units. For instructions, see the UPS manufacturer's user documentation.

When you turn on the UPS, the indicator light above the Main Power switch turns on.

3 Turn on the robot. To do this, on the power panel, turn the **ROBOT** switch counterclockwise to the on position. The indicator lights above the Main Power and Robot switches turn on.



To turn on the computer and devices:

1 Make sure the Ethernet and RS-232 hub power indicator lights are on. To do this, open the cabinet door opposite the power panel. The hubs are mounted on the rack just inside the doorway.

2 Turn on all integrated devices.

3 Turn on the computer monitor.

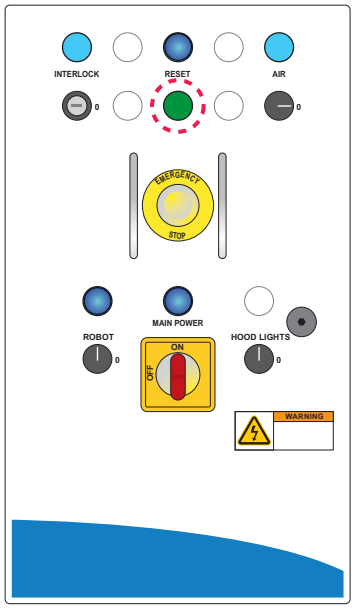
4 Turn on the controlling computer. See the computer manufacturer's user documentation for instructions.

5 Log in to the Microsoft Windows operating system.

6 Close the cabinet doors.

7 Make sure that the EMERGENCY STOP button on the power panel and the emergency stop buttons on the tabletop are pulled out (restored position).

8 Press the green **RESET** button on the power panel. If pressing the green RESET button does not turn on power at all the devices, check that the emergency stop buttons are pulled out (restored position).

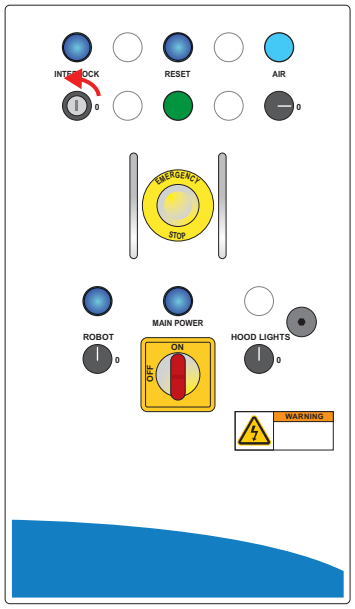


9 If there is a secondary computer for a third-party device, log in to the Windows operating system on that computer.

To turn on the interlock, air, and optional gases and devices:

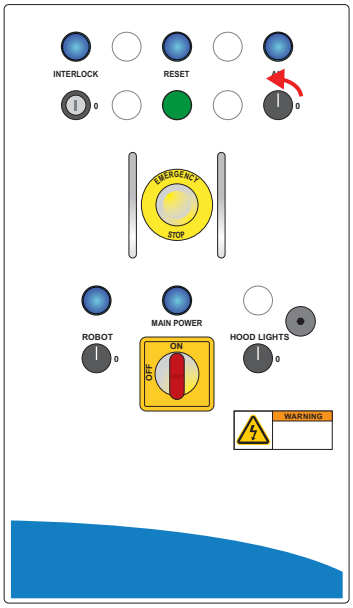
1 Turn on the safety interlock. To do this, on the power panel, turn the **INTERLOCK** key counterclockwise. The INTERLOCK indicator light turns on.

If you have a BioCel 900 System, and the system does not have light curtains, you can skip this step.



2 Turn on the air supply to the system. To do this, on the power panel, turn the **AIR** switch counterclockwise. The AIR indicator light turns on.

If the air does not come on, make sure the emergency stops buttons are pulled out (restored). Also, make sure the safety interlock is turned on (except if your BioCel 900 System does not have light curtains).



3 If you use devices that require a vacuum created by a vacuum pump:

- **a** Check that the gauge on the vacuum pump indicates a vacuum pressure.
- **b** Make sure that the vacuum system is connected correctly.

4 If you use devices that require a gas supply, make sure that the gas is turned on.

5 If the BioCel System has an incubator, turn on the incubator.

6 On the power panel, make sure that the indicator lights for RESET, AIR, ROBOT, and MAIN POWER are on. The INTERLOCK indicator light should also be on, except if your BioCel 900 System does not have light curtains.

If you have not previously selected the option to sense the air pressure automatically, check that the operating air pressures meet the requirements. See "System specifications" on page 5.

To start the VWorks software:

See the *VWorks Automation Control User Guide*.

Shutting down procedure

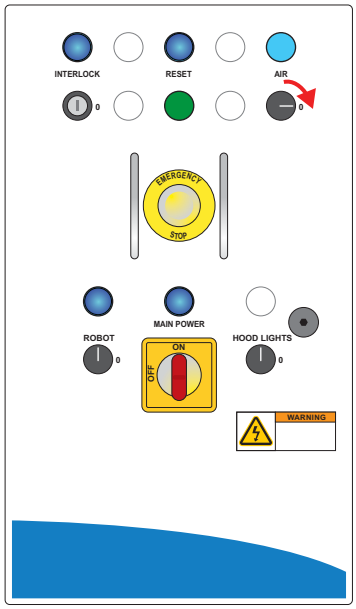
Shut down the BioCel System if you intend to:

- Leave it unused for a long period of time.
- Service the system.
- Move it to another location.

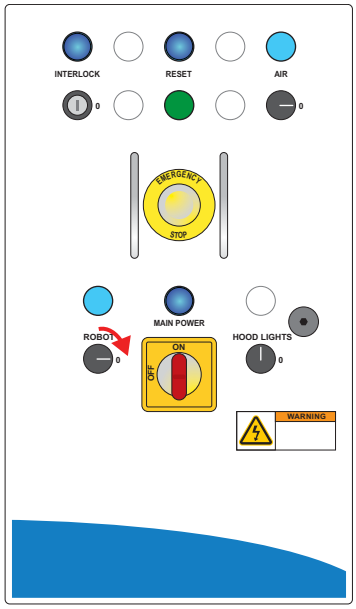
To shut down the BioCel System:

1. Make sure you have cleaned up after the last run. See "Cleaning up after every protocol run" on page 174 for cleanup instructions.
2. Exit the VWorks software. See the *VWorks Automation Control User Guide* for instructions.
3. If you have a secondary computer:
   a. Exit any software running.
   b. Shut down the secondary computer (through Windows).

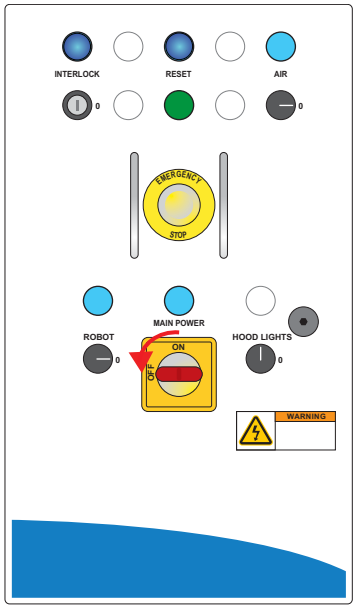
   Wait for the operating system to shut down.
4. Shut down the main computer through Windows. Wait for Windows to exit.
5. Turn off the computer monitor.
6. If you use devices that require a vacuum pump, optionally turn off power at the pump if the pump has a power switch.
7. Turn off the air. To do this, on the power panel, turn the **AIR** switch clockwise. The AIR indicator light turns off. When the air is turned off, the 3-Axis Robot and KiNEDx Robot grippers close.



8 Turn off the robot. To do this, on the power panel, turn the **ROBOT** switch clockwise to the off position.



9 Turn off the power on the power panel. To do this, on the power panel, turn the **Main Power** switch counterclockwise to the OFF position.



10 If you have one or more UPS units, open the cabinet door nearest the power panel, and then turn off the UPS units. For instructions, see the UPS manufacturer's user documentation.

11 If your are moving the BioCel System, disconnect the air, vacuum, other gases, Ethernet cables, and main power cables.

Related information

For information about...	See...
Electrical requirements	“System specifications” on page 5
Cleaning up after a protocol run	“Routine maintenance” on page 174
Troubleshooting startup or shutdown problems	“Troubleshooting error messages” on page 189

Adding and deleting devices in the software

About this topic

The supplied BioCel System computer is set up with the correct device configuration to communicate with the BioCel System and integrated devices. You do not need to create a new device file unless you want to reference different profiles or use a different teachpoint file. You need to update the device file if you add or remove devices in the BioCel System.

This topic explains how to add and delete the devices in the VWorks software. Read this topic if you are an administrator responsible for setting up and managing the BioCel System.

Devices and device file defined

A device is an item in your lab automation system that has an entry in the VWorks software device file. A device can be a robot, an instrument, or a location in the system that can hold a piece of labware. The following are some examples of devices:

- The robot in the BioCel System
- PlateLoc Thermal Microplate Sealer
- Microplate Labeler
- Vertical Pipetting Station shelf
- Platepad
- A third-party device integrated in the BioCel System

To communicate with and to control the robot and integrated devices, the VWorks software uses a device file that contains the following information:

- List of devices the software will communicate with and control
- Device type of each device (for example, the robot in the BioCel System, PlateLoc Thermal Microplate Sealer, and any integrated device)
- Configuration information of each device (for example, approach height, allowed or prohibited labware, barcode access, and so on)
- Profile to use

You provide the device information in the VWorks software. The device information is stored in a device (.dev) file that is located in a folder you specify when saving the file.

For detailed information about device files and associations with profiles, teachpoint files, and labware definitions, see the *VWorks Automation Control User Guide*.

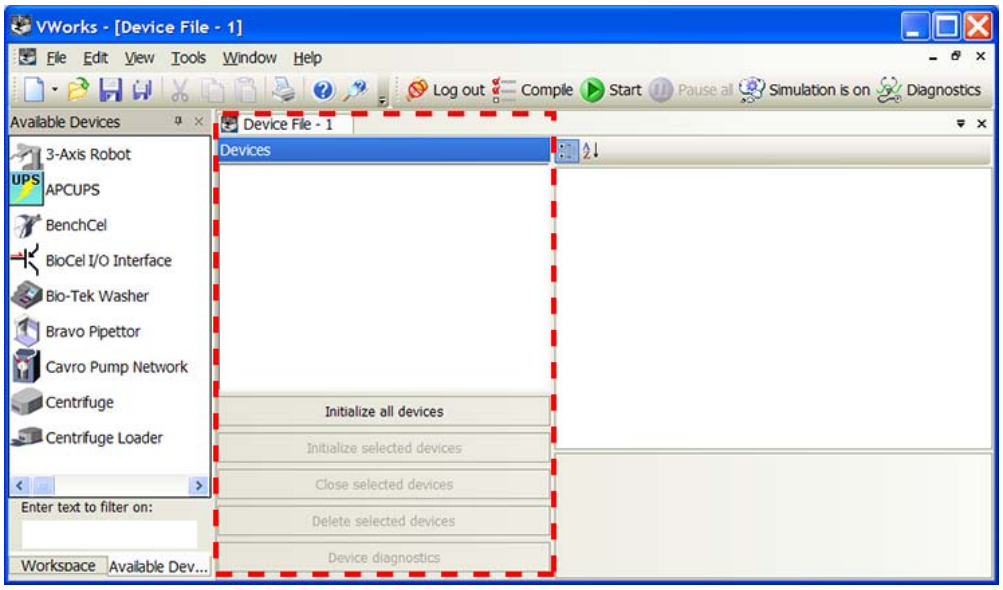
Creating a device file

If you are setting up the BioCel System for the first time, you need to create a new device file, and then add the BioCel System robot and integrated devices to this file.

Before you create a device file, start the VWorks software and log in. See the *VWorks Automation Control User Guide* for instructions.

To create a new device file:

1 In the **VWorks** window, select **File > New > Device.** A Device File tab appears.

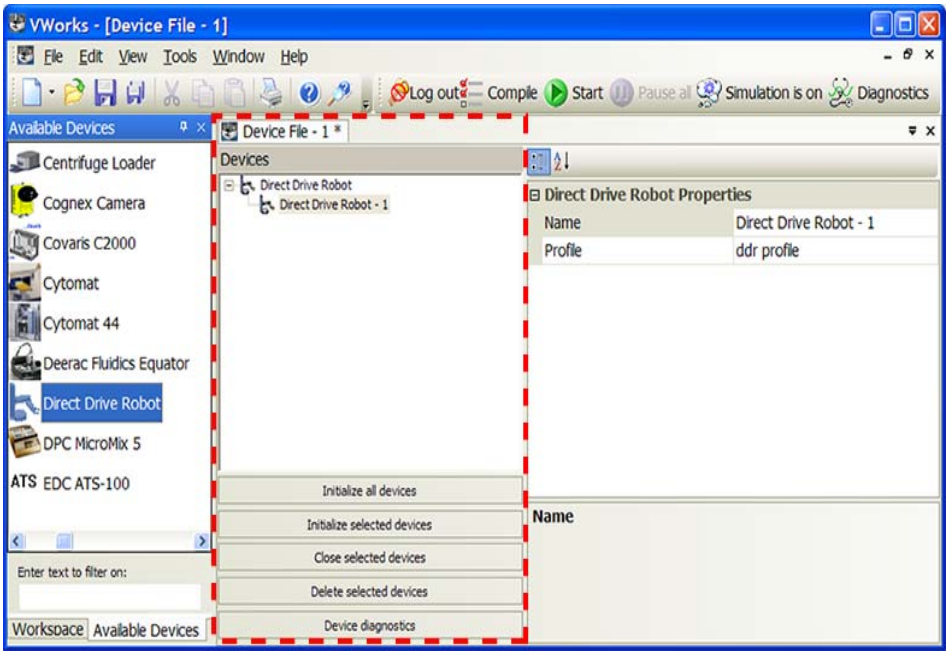


2 Select **File > Save** to save the device file. The file name appears in the Device File tab.

Adding a device

To add a device to the device file:

1 In the **Available Devices** area, double-click the device that you want to add. Alternatively, you can drag a device from the **Available Devices** area into the **Device File** area.



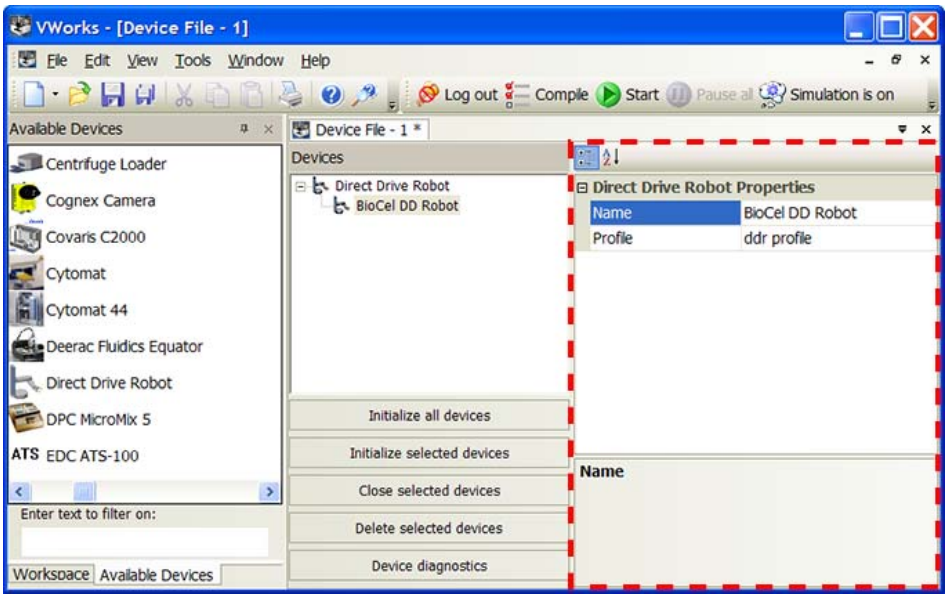
In the example shown, the Direct Drive Robot device is added. Notice that the first Direct Drive Robot device is labeled Direct Drive Robot-1. If you add another Direct Drive Robot device, it will appear as Direct Drive Robot-2.

If you do not see the device in the **Available Devices** list, check that the device plugin file is stored in the ...\Agilent Technologies\VWorks\Plugins folder.

If you added a device plugin file in the Plugins folder and you have already started the VWorks software, be sure to reload the plugin. To do this, close any open device files and protocol files, and then select **Tools > Reload Plugins.**

2 In the device properties area, type a **Name** for the device.

In the following example, the name for the Direct Drive Robot is BioCel DD Robot.



3 If applicable, select the **Profile**.

If the profile you want does not appear in the list, or if no profile appears in the list, you need to create the profile, and then return to this step to select it. Without the profile, you will not be able to establish communication with the device.

To create a profile for the BioCel System robot, see one of the following:

- "Creating and managing Direct Drive Robot profiles" on page 47
- "Creating and managing 3-Axis Robot profiles" on page 113
- "Creating and managing KiNEDx Robot profiles" on page 131
- *Staubli TX60 Device Driver User Guide*

To create a profile for an integrated device, see "Additional BioCel System Devices" on page 241, the device user guide, or the third-party device driver user guide.

4 If applicable, set the device properties. See "Additional BioCel System Devices" on page 241, the device user guide, or the third-party device driver user guide.

5 Select **File > Save** to save the device file.

6 Repeat steps 1 through 5 to add other devices.

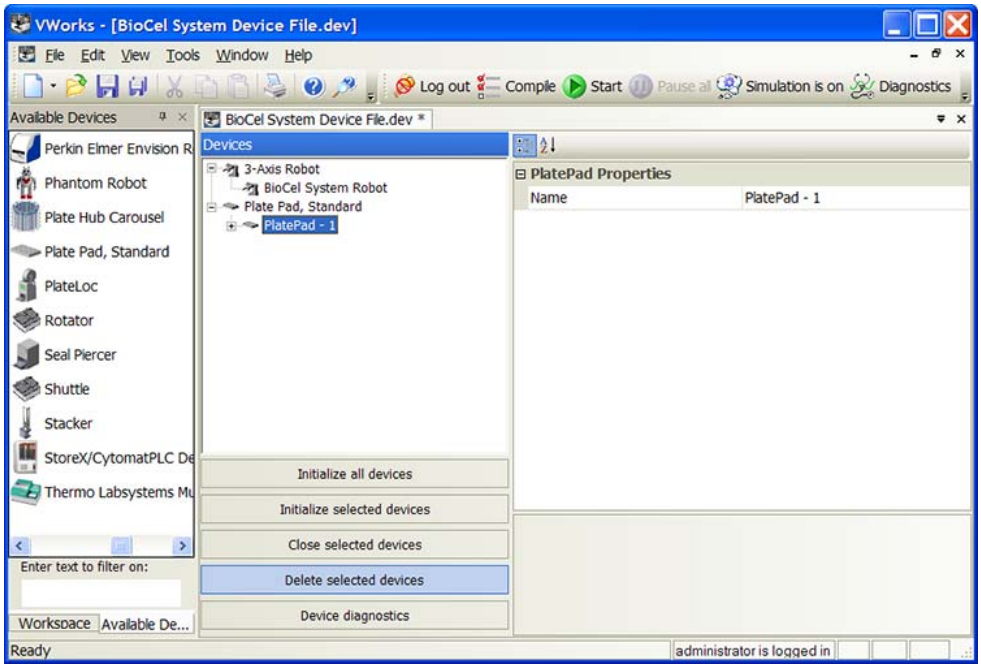
7 In the **Device File** area, click **Initialize all devices** to establish communication with the devices.

Deleting a device

To delete a device in the VWorks software:

1 In the **VWorks** window, select the device you want to delete in the **Devices** area.

2 Click **Delete selected devices.**



Related information

For information about...	See...
VWorks software	• *VWorks Automation Control Setup Guide* • *VWorks Automation Control User Guide*
Setting the properties of a particular device	One of the following: • "Additional BioCel System Devices" on page 241 • Device user guide • Third-party device driver guide

For information about...	See...
Creating profiles of a robot or device	One of the following: • "Creating and managing Direct Drive Robot profiles" on page 47 • "Creating and managing 3-Axis Robot profiles" on page 113 • "Creating and managing KiNEDx Robot profiles" on page 131 • *Staubli TX60 Device Driver User Guide* • "Additional BioCel System Devices" on page 241 • Device user guide • Third-party device driver user guide
Setting teachpoints	One of the following: • "Setting Direct Drive Robot teachpoints" on page 69 • "Setting 3-Axis Robot teachpoints" on page 117 • "Setting KiNEDx Robot teachpoints" on page 135 • *Staubli TX60 Device Driver User Guide* • "Additional BioCel System Devices" on page 241 • Device user guide • Third-party device driver user guide

3 Setting up the Direct Drive Robot

This chapter explains how to set up the Direct Drive Robot for operation. This chapter contains the following topics:

- "Setup Workflow" on page 46
- "Creating and managing Direct Drive Robot profiles" on page 47
- "Specifying the table dimensions and robot position" on page 53
- "Planning Direct Drive Robot teachpoints" on page 60
- "Setting Direct Drive Robot teachpoints" on page 69
- "Setting teachpoints using a labware" on page 88
- "Verifying Direct Drive Robot teachpoints" on page 90
- "Editing existing Direct Drive Robot teachpoints" on page 102
- "Managing Direct Drive Robot teachpoints" on page 106
- "Cycling teachpoints" on page 107

Note: If the BioCel System has a 3-Axis Robot, see "Setting up the 3-Axis Robot" on page 111. If the BioCel System has a KiNEDx Robot, see "Setting up the KiNEDx Robot" on page 129. If the BioCel System has a Staubli robot, see the *Staubli TX60 Device Driver User Guide*.

Setup Workflow

About this topic

This topic presents the workflow for setting up the Direct Drive Robot for operation.

Workflow

The following table presents the steps for setting up the Direct Drive Robot. After setting up the Direct Drive Robot for the first time, you will not likely change any of the settings in the procedure unless you add, replace, move, or remove a device in the system.

IMPORTANT Before proceeding to step 5 (verify the teachpoints), you should already have definitions for the labware you want to use. Although you can define labware at any time, Agilent Technologies recommends that you define labware before setting up the Direct Drive Robot. For instructions on how to define labware, see the *VWorks Automation Control Setup Guide*.

Step	For this task...	See...
1	Add the robot to the device file.	"Adding and deleting devices in the software" on page 39
2	Create a profile for the Direct Drive Robot.	"Creating and managing Direct Drive Robot profiles" on page 47
3	Specify the table dimensions and the robot position.	"Specifying the table dimensions and robot position" on page 53
4	Plan the teachpoints.	"Planning Direct Drive Robot teachpoints" on page 60
5	Set teachpoints for integrated devices.	"Setting Direct Drive Robot teachpoints" on page 69
6	Verify the teachpoints.	"Verifying Direct Drive Robot teachpoints" on page 90
7	Edit the teachpoints.	• "Editing existing Direct Drive Robot teachpoints" on page 102 • "Managing Direct Drive Robot teachpoints" on page 106
8	Cycle the teachpoints.	"Cycling teachpoints" on page 107
9	Perform dry runs.	"Performing dry runs" on page 153

Creating and managing Direct Drive Robot profiles

About this topic

The BioCel System computer is set up with the correct profiles to communicate with the Direct Drive Robot and integrated devices. You do not need to create new profiles unless you want to set up unique communication settings or use a different teachpoint file. When you integrate a new device in the BioCel System, you will need to create a new profile for that device.

This topic explains how to create a new profile for the Direct Drive Robot and how to manage existing profiles. For instructions on how to create the profiles for Agilent Technologies devices, see the device user documentation. For instructions on how to create profiles for third-party devices, see the third-party device driver user guide.

About profiles

IMPORTANT Each device you integrate in the BioCel System requires a unique profile.

A profile is a collection of settings, stored in the Windows registry, that manages how you connect to a device. A profile:

- Specifies the port or IP address used to establish communication between the device and the controlling computer.
- References a teachpoint file. For a description of teachpoint files, see "Setting Direct Drive Robot teachpoints" on page 69.

You use the DDR Diagnostics software to create and manage profiles.

Note: The profile is referenced by a device file. For information about device files, see "Adding and deleting devices in the software" on page 39. For a detailed description of the relationships between the device file, profile, and teachpoint file, see the *VWorks Automation Control User Guide*.

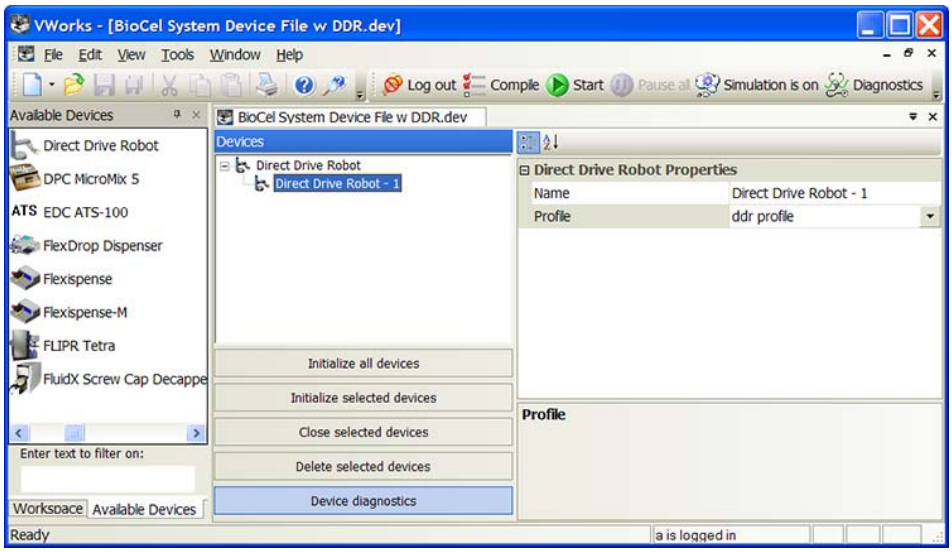
If you have more than one Direct Drive Robot in the system

Every device in the system must have a unique IP address for proper operation. All Direct Drive Robots are assigned the same IP address at the factory. Therefore, if you have more than one Direct Drive Robot installed in the system, you must make sure each is assigned a unique IP address. You can do this when creating a profile for the robot.

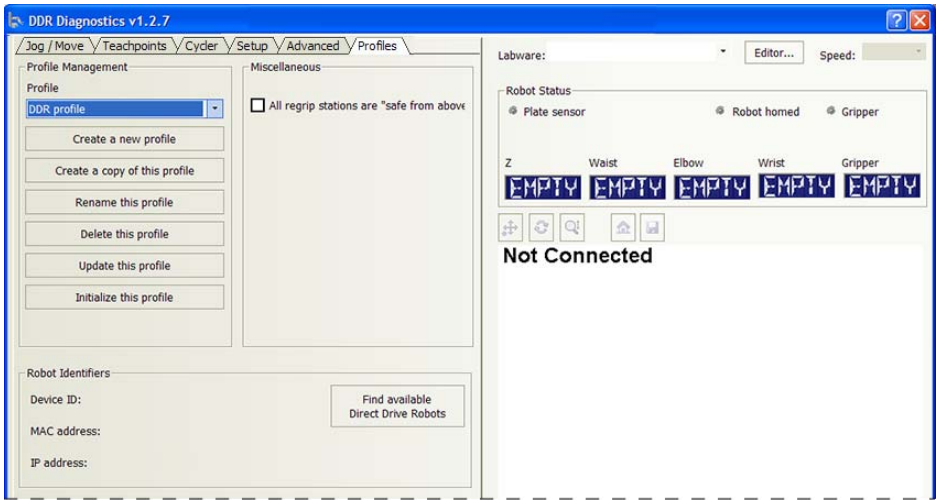
Creating a Direct Drive Robot profile

To create a Direct Drive Robot profile:

1 In the **Devices** area, select the Direct Drive Robot name, and then click **Device diagnostics.**



The DDR Diagnostics dialog box opens.



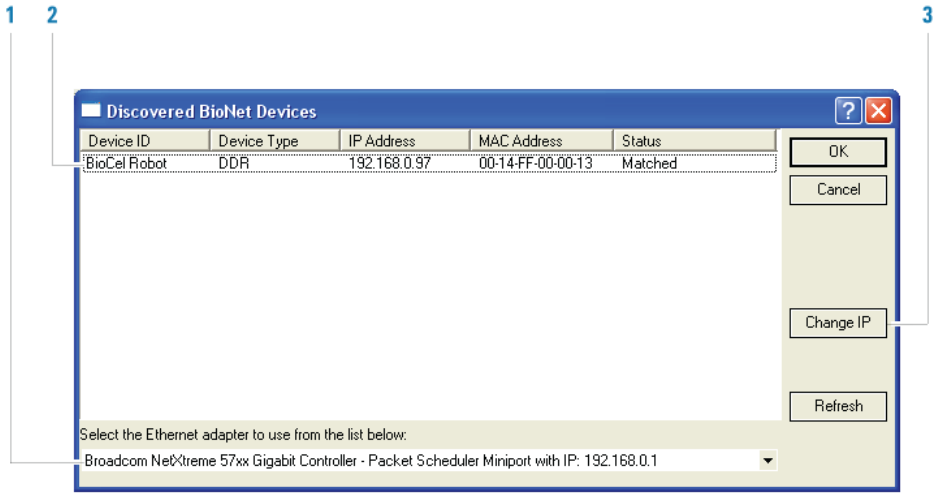
2 If it is not already displayed, click the **Profiles** tab.

3 In the **Profile Management** area, click **Create a new profile**. The Create Profile dialog box opens.

4 Type a name, and click **OK**. The name appears in the Profile Management area.

5 In the **Robot Identifiers** area, click **Find Available Direct Drive Robots.** The Discovered BioNet Devices dialog box opens.

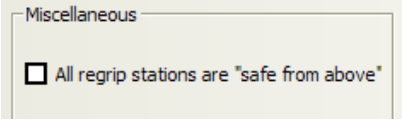
6 Locate the Direct Drive Robot to which you want to connect:



Step	Instruction
1	Select the correct Ethernet card for the device connection. A list of devices appear in the dialog box.
2	Select the Direct Drive Robot. You can use the MAC Address to identify the robot in the list. To successfully communicate with the robot, the device must show New or Matched in the Status column. To correctly identify a robot by its MAC address, you might need to turn off all devices and all but one robot in the system. After you have correctly identified the robot in the list, double-click the **Device ID** box and type a name for the robot.
3	If you have more than one Direct Drive Robot in the system, make sure each robot has a unique IP address. To do this, turn off all but one robot in the system, select the robot in this dialog box, click **Change IP**, and then assign a new IP address. The IP address should have the same network and subnet address as the controlling computer, and have a unique host address. Repeat for each robot in the system.

When you are finished, click **OK** to return to the DDR Diagnostics dialog box. Notice that the Device ID, MAC address, and IP address of the robot appear in the Robot Identifiers area.

7 In the **Miscellaneous** area, make sure the **All regrip stations are safe from above** check box is not selected. You can return to the profile to select this option after you have set all teachpoints.



For a description of this option, see "Selecting the All regrip stations are safe from above option" on page 87.

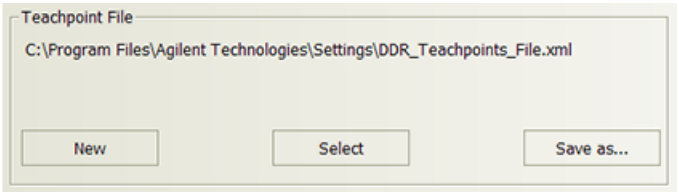
CAUTION Select this option only if all regrip stations in the system are clear of obstacles, such as shelves or other devices, above them.

8 To save the profile using the default teachpoint file name and location that the software automatically creates, proceed to step 9. Later you will add teachpoints to this teachpoint file.

If you want to use an existing teachpoint file, in the Teachpoint File area, click **Select.** In the Select a Teachpoint File dialog box, locate and select the teachpoint file that you want to use, and then click **Open.** The file path appears in the Teachpoint File area.

CAUTION If the teachpoint file was copied from another computer, you must verify the teachpoints for the new profile before using it.

If you want to change the teachpoint file name or storage location, in the Teachpoint File area, click **Save as.** In the Save As dialog box, type a name for the teachpoint file, select the storage location, and then click **Save.** The file path appears in the Teachpoint File area. Later you will add teachpoints to this file.



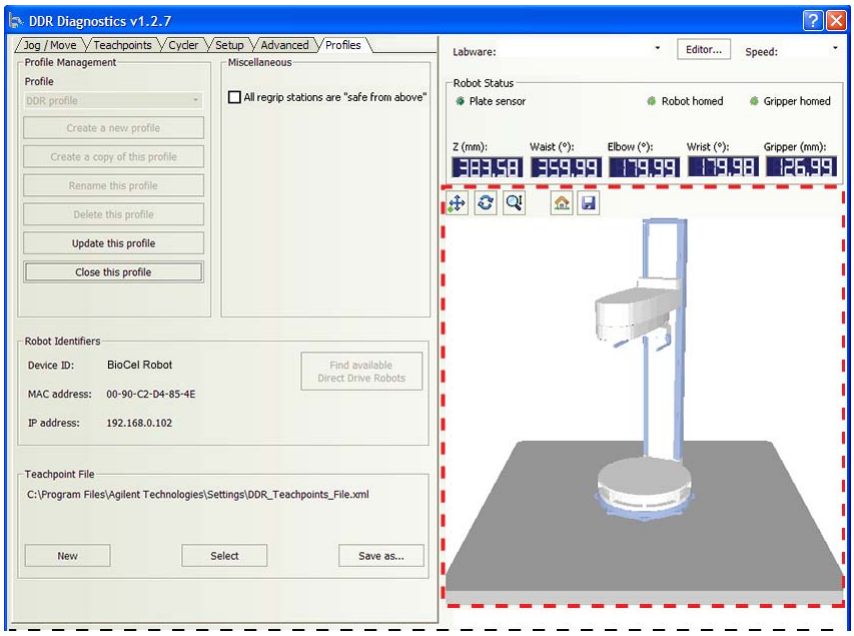
Note: If you want to use an existing teachpoint file and rename it, you must select the existing teachpoint file, initialize the profile to load information in the existing teachpoint file (step 10), and then click **Save As** in the Teachpoint File area to rename it.

9 Click **Update this profile** to save the changes.

10 Click **Initialize this profile** to:

- Establish communication with the robot.
- Load the information in the selected teachpoint file. In the Robot Status area, a graphical representation of the robot and teachpoints (if any) appear. In addition, the robot coordinates are updated.

IMPORTANT The system table displayed in the Robot Status area should be representative of the actual system table. If the dimensions in the image appears to be incorrect (for example, a rectangular table appears in the software but the actual system table is square), contact Automation Solutions Technical Support.



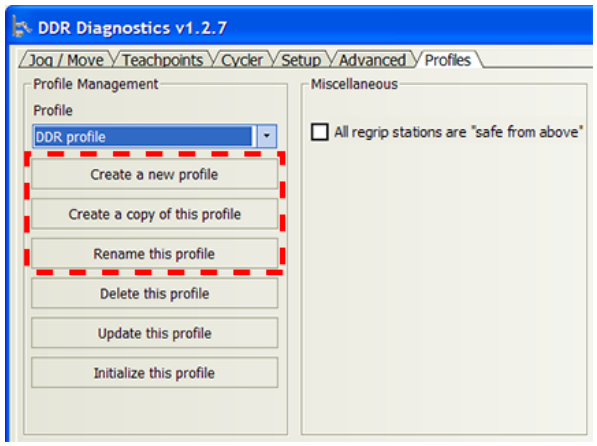
Note: During the initialization process, the teachpoints information in the firmware is synchronized with the information in the teachpoints file.

11 If you are setting up the BioCel System for the first time or if you are creating a new device file, return to "Adding and deleting devices in the software" on page 39 and continue from step 3. Otherwise, you can proceed to set teachpoints. See "Planning Direct Drive Robot teachpoints" on page 60.

Managing existing profiles

In the DDR Diagnostics **Profiles** tab, you can select an existing profile, and then rename, copy, or delete the profile.

CAUTION A copy of an existing profile references the same teachpoint file.



Related information

For information about...	See...
Adding a device in the VWorks software	"Adding and deleting devices in the software" on page 39
Setting teachpoints	• "Planning Direct Drive Robot teachpoints" on page 60 • "Setting Direct Drive Robot teachpoints" on page 69

Specifying the table dimensions and robot position

About this topic

The Direct Drive Robot is already set up correctly in the BioCel System. You do not need to re-specify the table dimensions or robot position unless you have moved the robot to a different position in the same system, or you have moved the robot to a different system.

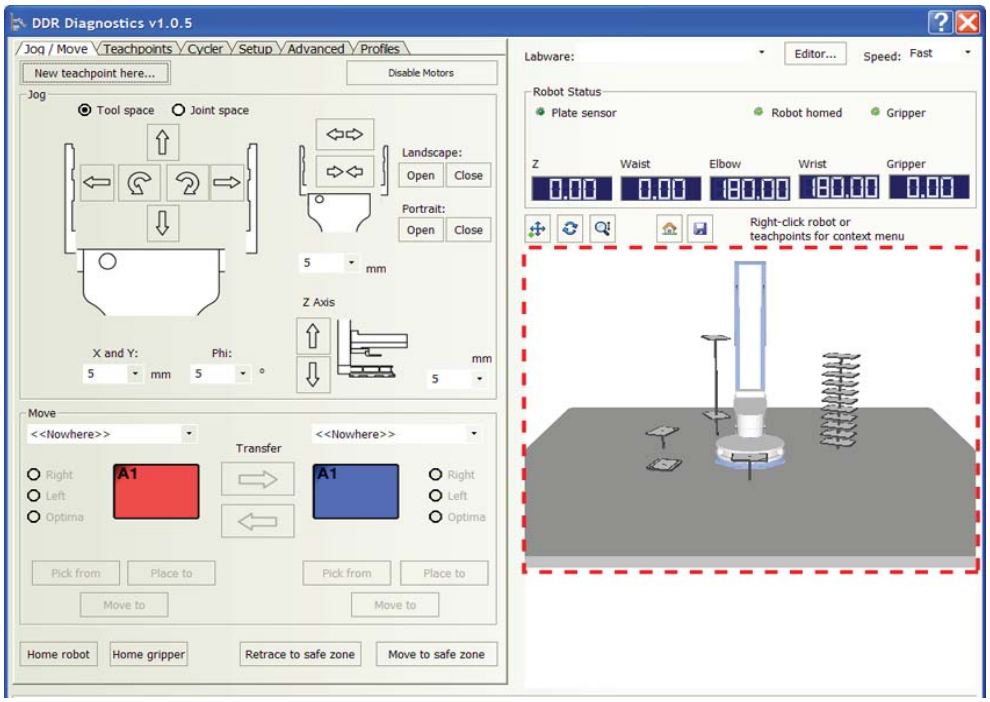
This topic explains how to specify the table dimensions and the robot position.

About the table dimensions and robot position

When you set up the robot, you must let the software know the following:

- Dimensions of the attachment surface (or table)
- Position of the robot on the table
- Orientation of the robot on the table

This information helps the software to draw an accurate representation of the table and display the relative positions of the robot and teachpoints in the Robot Status area.



To specify the table dimensions and robot position, you will be:

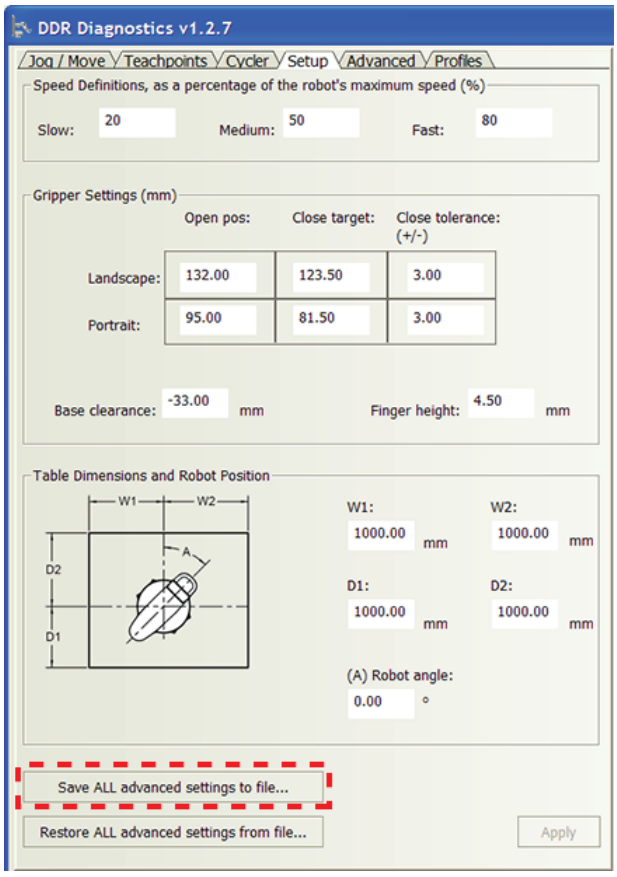
- “Backing up existing settings” on page 54
- “Measuring the table dimensions” on page 54
- “Determining the angle of the robot” on page 55
- “Entering the information in DDR Diagnostics” on page 57

Backing up existing settings

Agilent Technologies recommends that you back up existing table dimensions and robot position settings before changing them.

To back up existing settings:

1 In the **DDR Diagnostics Setup** tab, click **Save ALL advanced settings to file.**

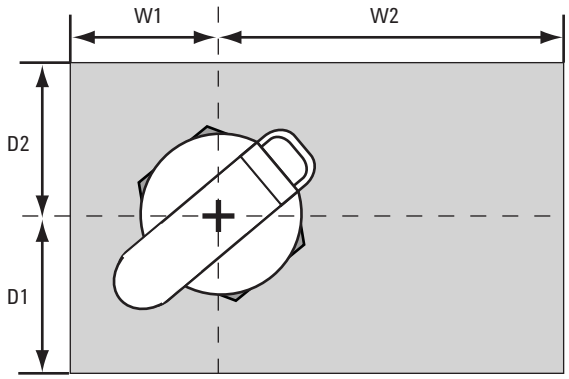


2 In the Save As dialog box that opens, type a name for the backup file. You can use the default backup file location, or select a different location. The default location is C:\Program Files\Agilent Technologies\Settings\DDR\FirmwareBackup.

3 Click **Save.** The robot settings are saved in an XML file.

Measuring the table dimensions

Take the measurements that are shown in the following diagram. The crosshair symbol in the diagram marks the center of the robot. The *W*-axis is width of the robot-attachment surface. W1 and W2 specify the lengths of the two segments of the width. The line that intercepts the end of W1 and the beginning of W2 runs through the center of the robot base. The *D*-axis is the depth of the robot-attachment surface. D1 and D2 specify the lengths of the two segments of the depth. The line that intercepts the end of D1 and the beginning of D2 runs through the center of the robot base.

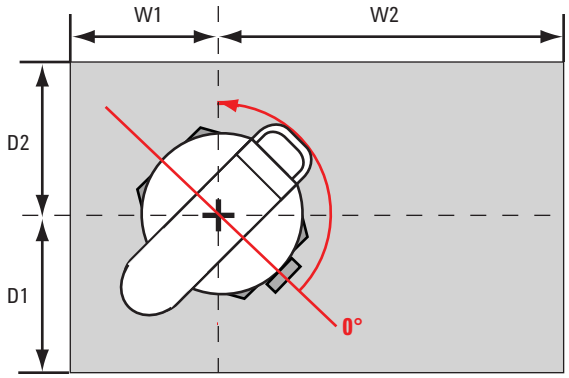


Note: The measurements can be approximate and the axis assignment is arbitrary. The information is used to draw the graphic in BioCel 900 Diagnostics and is not used for robot operation.

Determining the angle of the robot

During this procedure, you will determine the angle between the robot 0° position relative to the *D*-axis. The robot is at its 0° position when the mast sits directly above the robot cable connection.

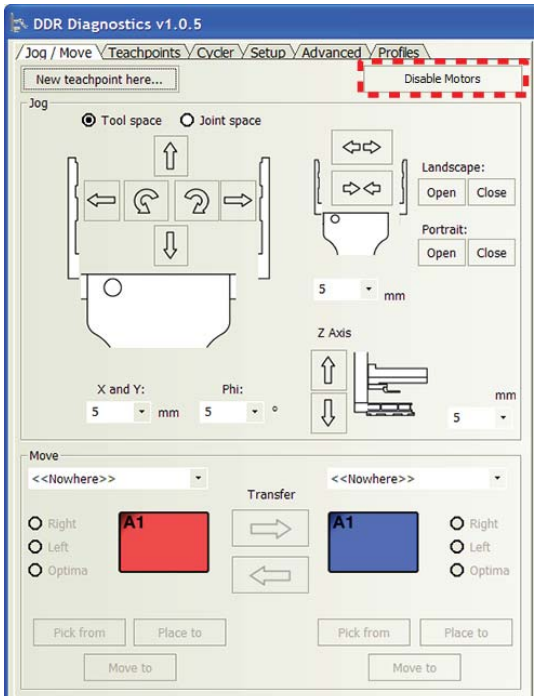
The following diagram shows the robot rotated halfway between the 0° position and the *D*-axis. Notice the location of the robot cable connection (the gray rectangular block).



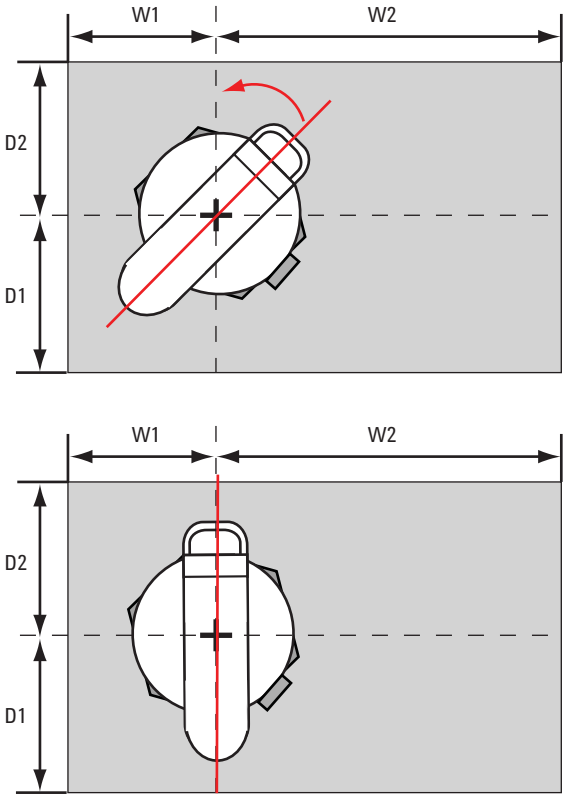
WARNING **Be sure to wear protective eyewear when entering the system and working with the robot.**

To determine the angle of the robot:

1 In DDR Diagnostics, click the **Jog/Move** tab, and then click **Disable Motors.** You should be able to rotate the robot waist and arm manually without resistance.



2 Turn the robot waist such that the bicep is parallel to the *D*-axis and the mast is in the D2 half of the plane.

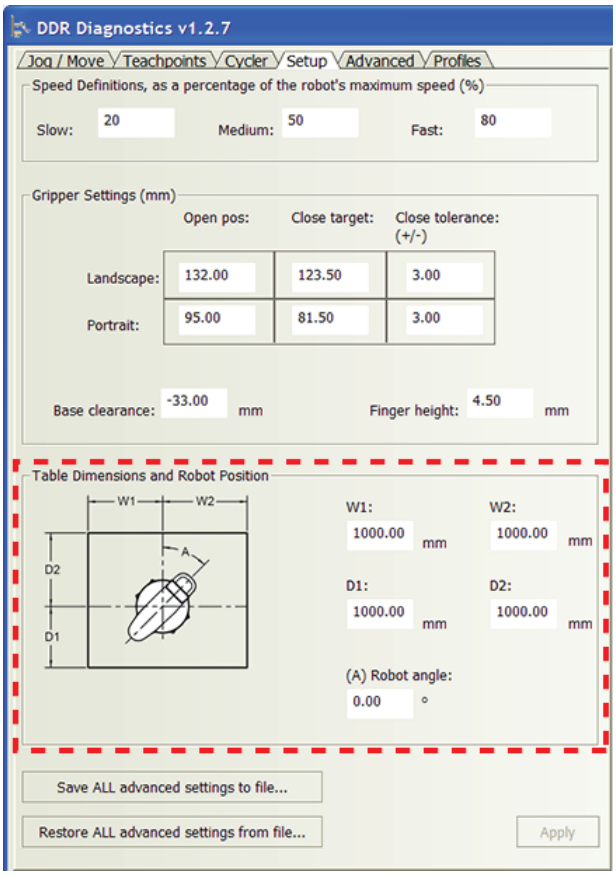


3 In DDR Diagnostics, note the **Waist** angle in the **Robot Status** area. This is the robot angle value you will use.

Entering the information in DDR Diagnostics

To set or update the table dimensions and robot position

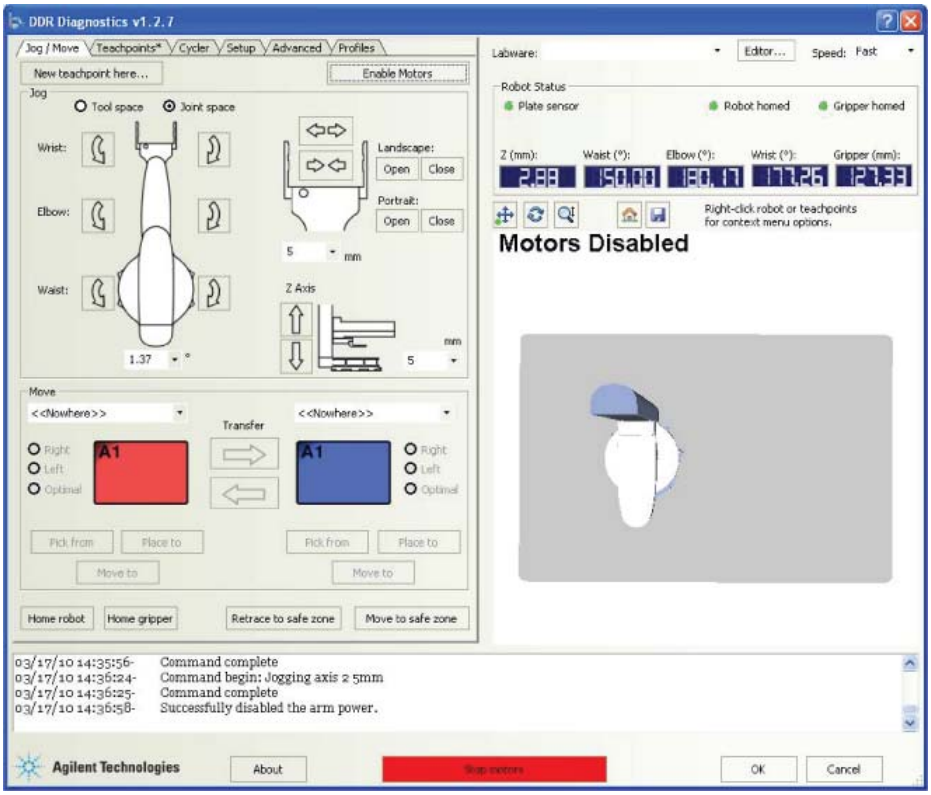
1 In DDR Diagnostics, click the **Setup** tab.



2 In the **Table Dimensions and Robot Position** area, type the desired values that define the table: **W1**, **W2**, **D1**, and **D2.**

3 Type the **Robot angle** value. This is the Waist angle value displayed in the Robot Status area.

4 When you are finished, click **Apply.** The changes are saved to the firmware. In addition, the graphic in the Robot Status area updates.



5 Check the graphic and make sure it is correct. If necessary, repeat the procedures in this topic to make any necessary adjustments. For example, if the robot appears backwards in the software, you can rotate the D- and W-axes in the Setup tab.

6 After you have verified that the table settings are correct, click **Save ALL advanced settings to file.** The values in the Setup tab are saved to an XML file. You can use the XML file to recover the settings if they are lost.

Related information

For information about...	See...
Adding a device in the VWorks software	"Adding and deleting devices in the software" on page 39
Setting teachpoints	• "Planning Direct Drive Robot teachpoints" on page 60 • "Setting Direct Drive Robot teachpoints" on page 69

Planning Direct Drive Robot teachpoints

About this topic

The Direct Drive Robot is able to hold labware in both the landscape and portrait orientations. In addition, the A1 well can be away or toward the robot grippers in either labware orientation.

The orientation flexibility permits multiple options at each teachpoint. Carefully planned teachpoints can optimize results and throughput. This topic presents the following:

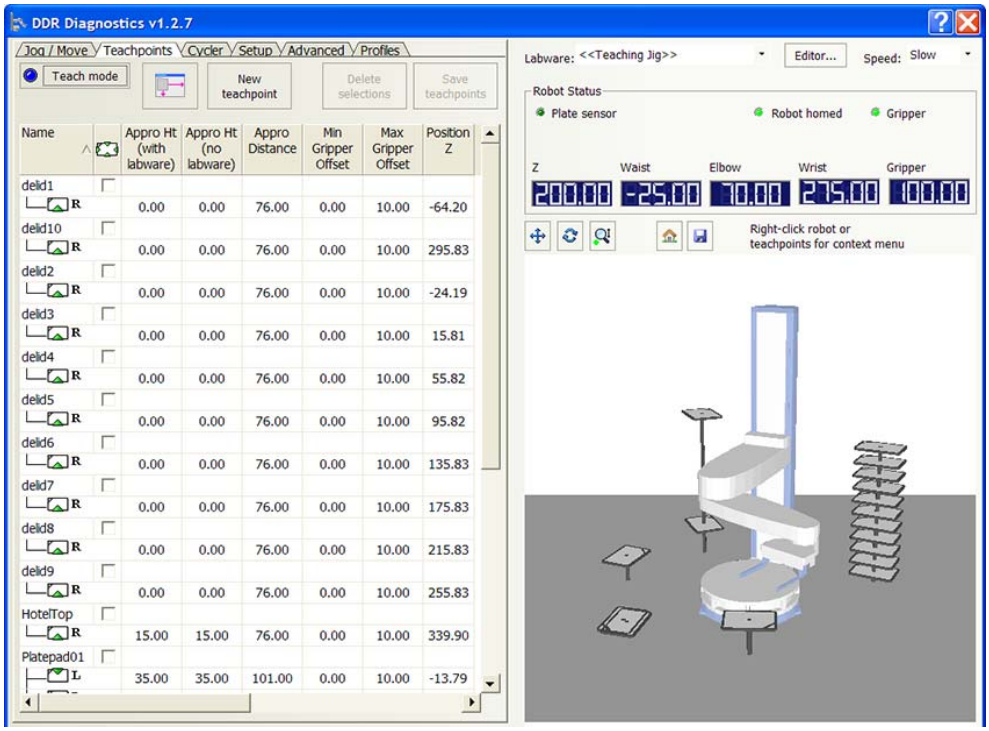
- "Direct Drive Robot teachpoints" on page 60
- "Guidelines for setting teachpoints" on page 63
- "Examples" on page 64

Direct Drive Robot teachpoints

A Direct Drive Robot teachpoint consists of the following:

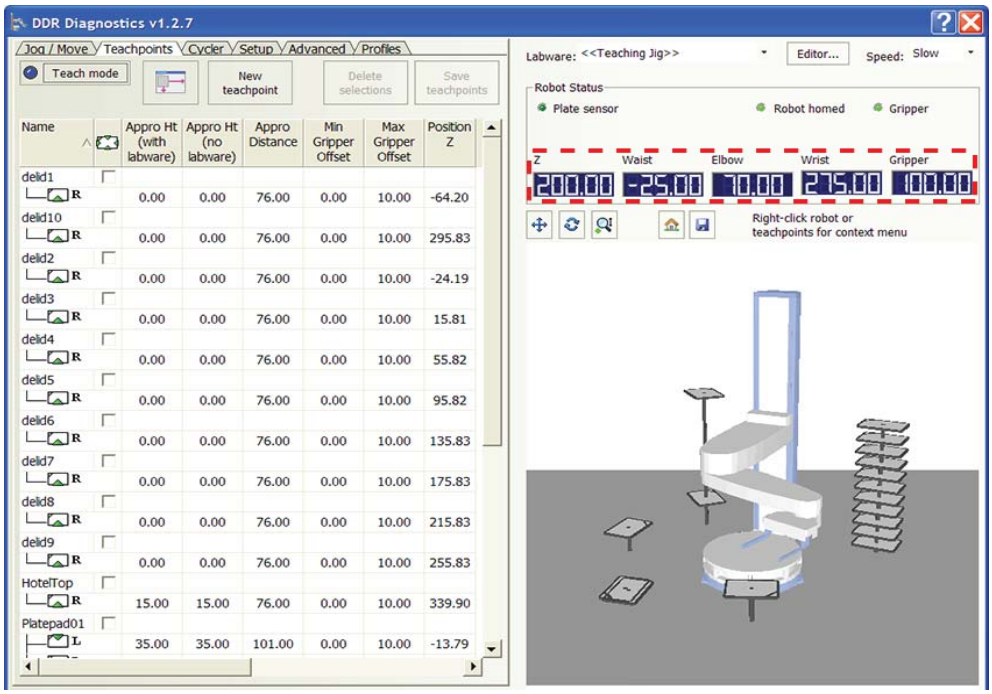
- Orientation coordinates
- Orientation information
- Parameters that define robot movements near and at the teachpoint

You set and edit teachpoints in the DDR Diagnostics Teachpoints tab.



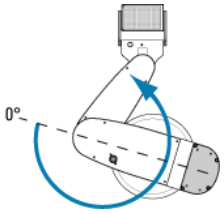
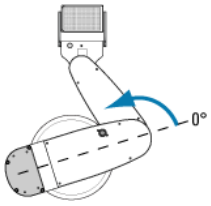
Orientation coordinates

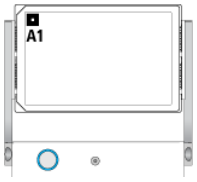
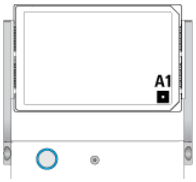
A teachpoint is defined by a set of coordinates that define where the robot picks up or places labware. The teachpoint can be on an integrated device or a platepad. Teachpoints are relative to the robot home position. You can view the teachpoint or robot coordinates in the Teachpoints tab in DDR Diagnostics.



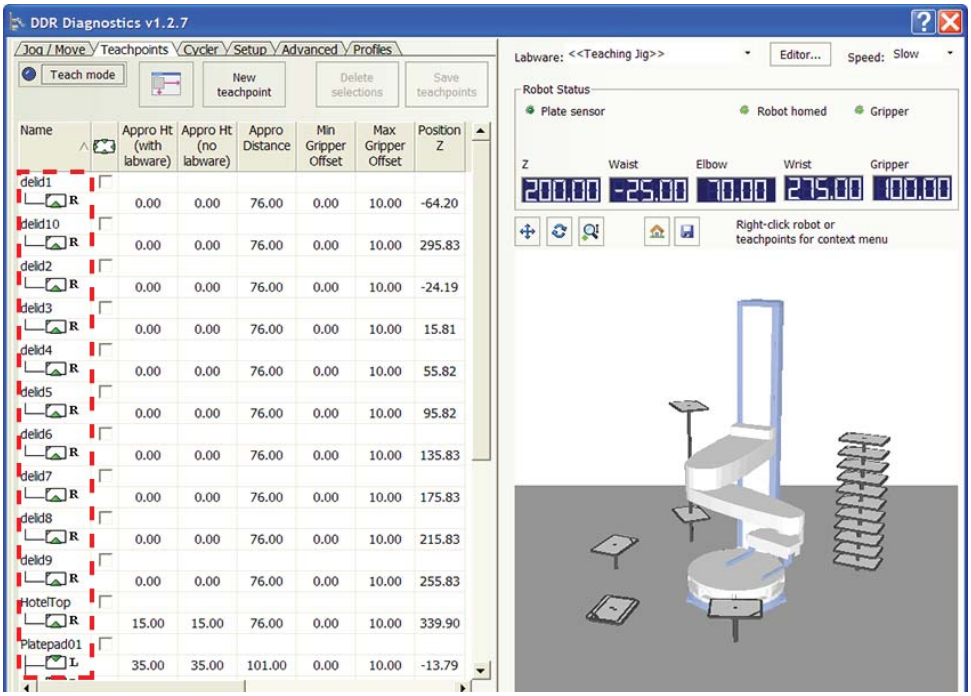
Orientation information

Each teachpoint contains the following orientation information:

Orientation	Description	
Robot arm	Left (L), elbow joint angle of >= 180°	Right (R), elbow joint angle < 180°
		
Labware	Landscape	Portrait

Orientation	Description	
A1 well	Away from the robot grippers in either labware orientation	Toward the robot grippers in either labware orientation
		

The orientation information is displayed in the Teachpoints tab in DDR Diagnostics.



Parameters that define robot movements

A number of parameters define the robot movements near or at a teachpoint:

- Approach height
- Approach distance
- Gripper offset at the location
- Custom actions (delidding, lidding, or stirring action)

For more information, see “Creating a new teachpoint” on page 74.

Guidelines for setting teachpoints

Before setting teachpoints, determine the best orientations for each location. In addition, be aware of how varying robot and labware orientations between teachpoints can affect robot speed and efficiency.

Orientations to consider

Before you set a teachpoint, take into consideration all of the following:

- *Robot-arm orientation*. Determine the best robot-arm orientation (left or right) for the location. The accessibility of a location can determine the robot-arm orientation. See "Examples" on page 64.
- *Labware orientation*. Determine the best labware orientation (landscape or portrait) for the location. The orientation might be determined by device requirements. For example, the Labware Stacker requires labware to be in the landscape orientation, but the portrait Plate Hub Carousel requires labware to be in the portrait orientation.
- *A1-well orientation*. Determine the A1-well orientation of the labware. In general, for devices that require the landscape orientation, such as the Labware Stacker and the landscape Plate Hub Carousel, the optimal A1-well orientation is typically away from the grippers. For storage devices that require the portrait orientation, the optimal A1-well orientation depends on the requirements at other teachpoints in the system. See "Examples" on page 64.

For a description of the orientations, see "Orientation information" on page 61.

Factors that affect robot speed and efficiency

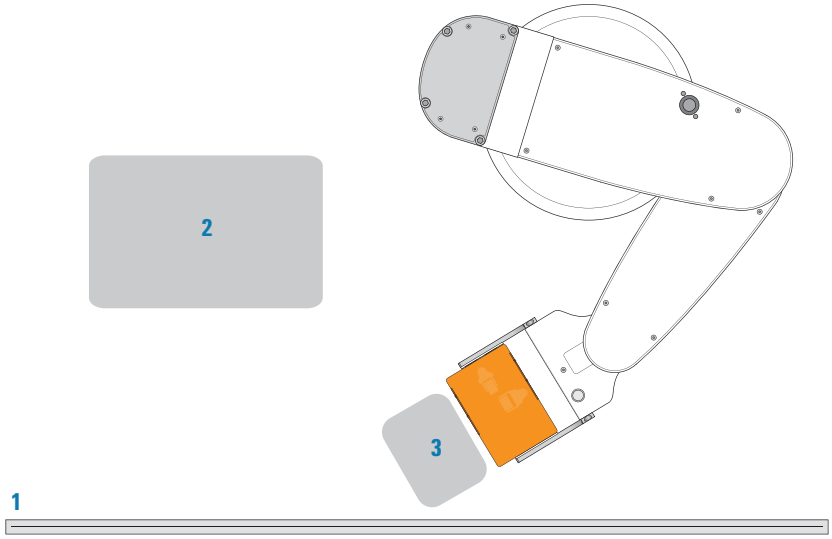
To increase robot speed and efficiency, you should:

- *Maximize the robot's ability to plan optimal paths*. Wherever possible, set a teachpoint with as many orientations as possible so that the robot can determine the optimal path during the run. For example, set a teachpoint with both the right- and left-arm orientations.
- *Minimize the number of regrips between teachpoints*. A regrip is required if, for example, the robot is transferring a labware from one location that requires one labware orientation to another location that requires a different labware orientation. To minimize the time required for regripping, wherever possible, set a teachpoint with multiple orientations and allow the robot to determine the optimal path during the run. Alternatively, consistently set teachpoints using one orientation wherever possible. For more information about regrip stations, see "Designating a teachpoint as a regrip station" on page 77.
- *Maximize the gripper offset ranges*. A regrip station is also used if the robot needs to adjust gripping height as it transfers a labware from one location that requires a gripper height that is different from the next location. To provide the system with the greatest flexibility for identifying a grip position that works for all locations, you should set the widest possible range for each gripper offset parameter. For more information about gripper offset ranges, see "Setting the gripper offset parameters" on page 83.
- *Set Approach Distance at the smallest possible value*. In general, rotating robot movements are faster than straight movements. To ensure that the robot rotates from the safe zone directly to the teachpoint, set the Approach Distance at 0. If obstacles near or at the teachpoint does not permit the rotating movement, set the Approach Distance at the smallest possible value for the location. For more information, see "Setting the approach distance" on page 81.

Examples

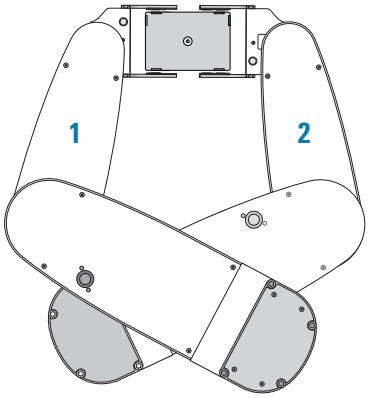
Example 1: Robot-arm orientation

In the following example, the system window (1) and an adjacent device (2) are two obstacles near the desired location (3). Therefore, the left-arm orientation should be used when setting the teachpoint.



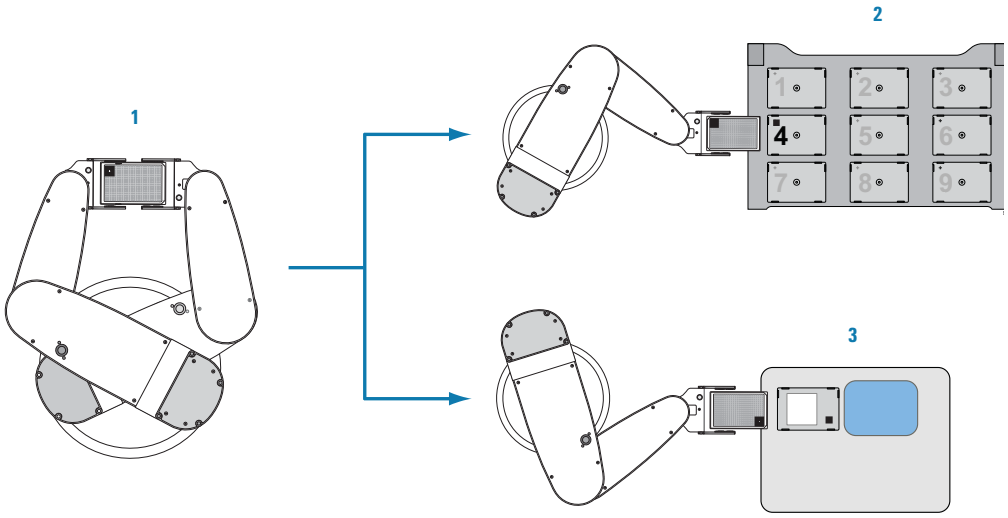
Example 2: Robot-arm and A1-well orientation

In the following example, there are no obstacles near the platepad in the portrait orientation. You can set the platepad teachpoint with the left- (1) and right-arm (2) orientations.



The position of the A1 well is device dependent. So the arm orientation the robot uses at this platepad is determined by the A1-well orientation at the next teachpoint.

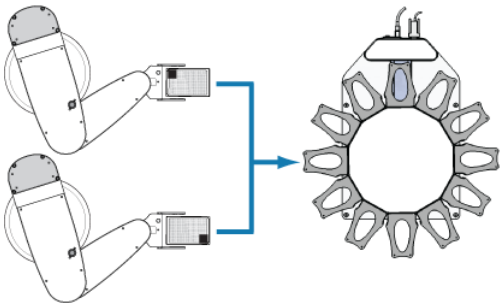
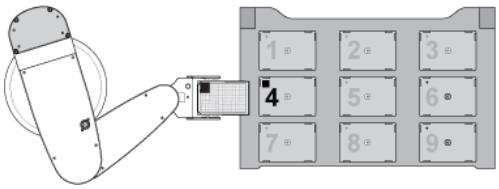
In the following example, the labware is placed at the platepad with the A1 well positioned as shown (1). If the next device requires the A1 well to be toward the grippers (2), the robot will use the left-arm orientation. However, if the next device requires the A1 well to be away from the grippers (3), the robot will use the right-arm orientation.



Example 3: Plate Hub Carousel - Bravo deck location 4 - Plate Hub Carousel

A protocol requires labware to be moved from a portrait Plate Hub Carousel slot to the Bravo Platform for liquid-handling tasks. After processing, the labware must be moved from the Bravo Platform and returned to the portrait Plate Hub Carousel slot.

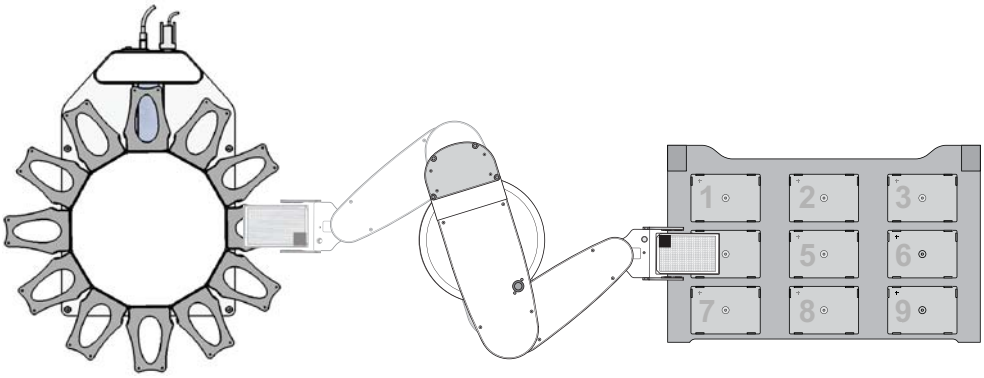
The labware orientation option or requirement at each device is as follows:

Device	Orientation option or requirement
Portrait Plate Hub Carousel (top view): • Portrait • A1 either away or toward the grippers	
Bravo Platform (top view): • Portrait • A1 toward the grippers	

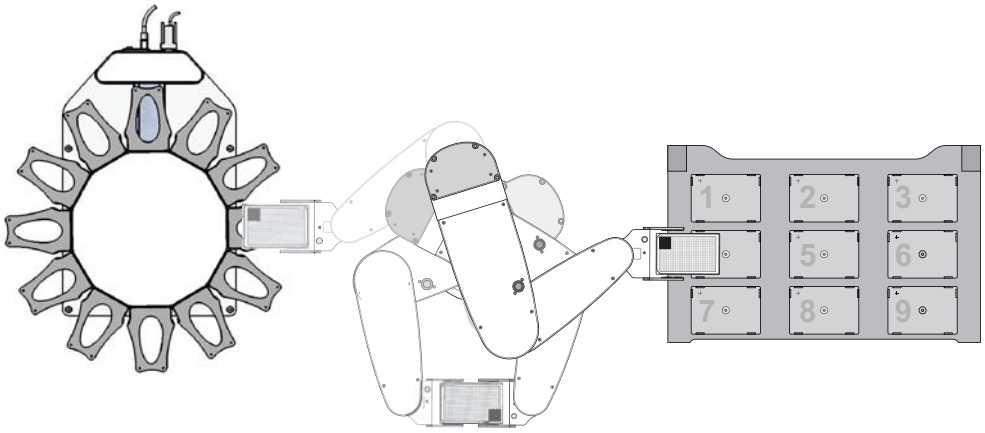
Note: In the example setup, the robot can only approach the Bravo deck as shown.

The optimal teachpoint setup at the Plate Hub Carousel would require the least number of regrips as the labware is transferred between the two devices.

If the Plate Hub Carousel teachpoint is set with the A1-toward orientation, the robot can transfer the labware from the Plate Hub Carousel to the Bravo Platform without regripping. Therefore, the A1-toward orientation at the Plate Hub Carousel is the optimal setup.



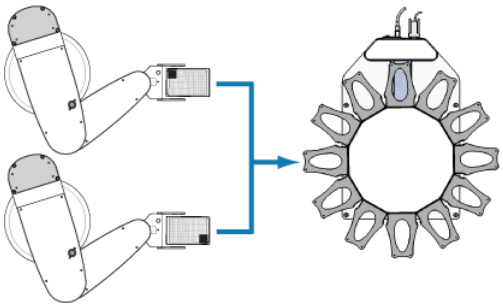
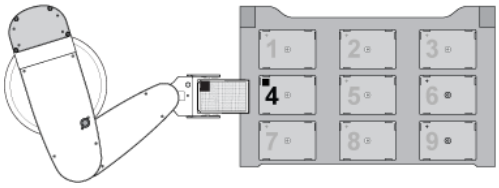
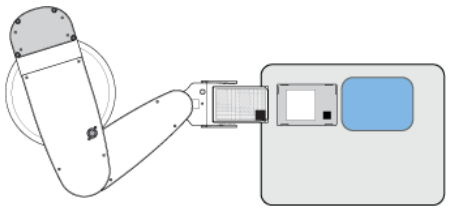
If the Plate Hub Carousel teachpoint is set with the A1-away orientation, the robot must regrip the labware during the transfer. Therefore, the A1-away orientation at the Plate Hub Carousel is not the optimal setup.



Example 4: Repeating tasks and regrip frequency

A protocol requires labware to be moved from a portrait Plate Hub Carousel slot to the Bravo Platform for liquid-handling tasks. After processing, the labware must be moved from the Bravo Platform to a dispenser. Subsequent protocol tasks move the labware multiple times between the dispenser and the Plate Hub Carousel for cycles of dispensing and incubation.

The labware orientation option or requirement at each device is as follows:

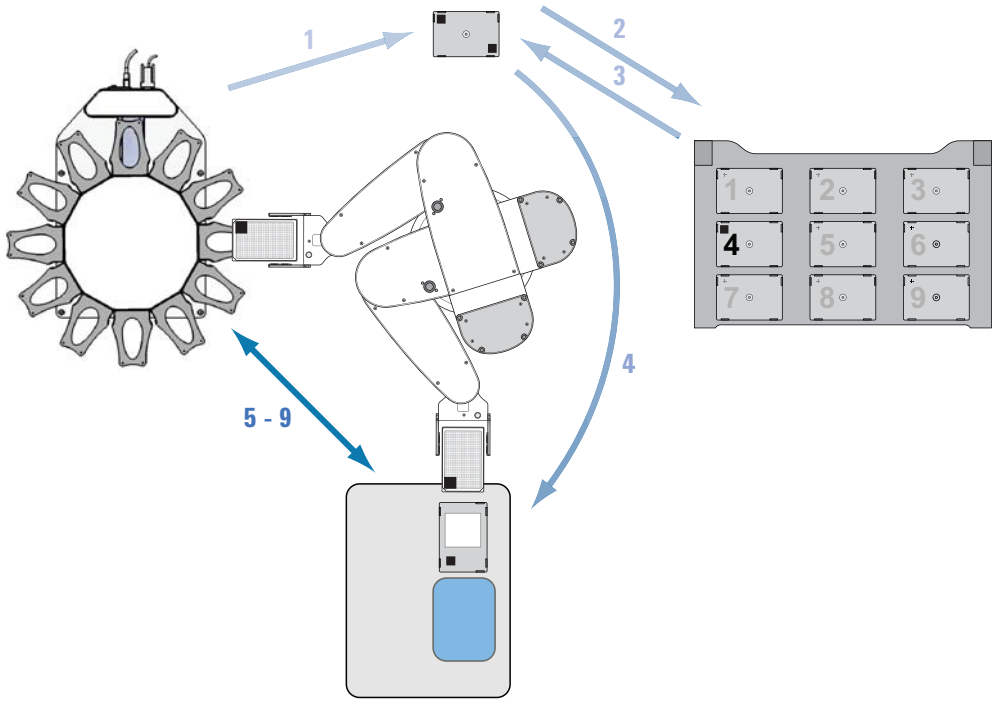
Device	Orientation option or requirement
Portrait Plate Hub Carousel (top view): • Portrait • A1 either away or toward the grippers	
Bravo Platform (top view): • Portrait • A1 toward the grippers	
Dispenser (top view): • Portrait • A1 away from the grippers	

Note: In the example setup, the robot can only approach the Bravo deck and the dispenser as shown.

The optimal teachpoint setup at the Plate Hub Carousel would require the least number of regrips as the labware is transferred between the three devices.

If the Plate Hub Carousel teachpoint is set with the A1-away orientation, the robot must regrip as it moves labware from the Plate Hub Carousel to the Bravo deck (**1**, **2**), and regrip again as it moves the labware from the Bravo deck to the dispenser (**3**, **4**). Thereafter, the robot can move the labware between the dispenser and Plate Hub Carousel without regripping (**5**–**9**). So the total number of regrips in this scenario is two.

Note: In general, to minimize the number of regrips, consider matching the orientations of consecutive teachpoints in repeating protocol tasks.



If the Plate Hub Carousel teachpoint is set with the A1-toward orientation, the robot can move labware from the Plate Hub Carousel to the Bravo deck without regripping. However, the robot must regrip as it moves labware from the Bravo deck to the dispenser, and then multiple times as it moves labware between the dispenser and Plate Hub Carousel in cycles of dispensing and incubation. The total number of regrips is greater than two. Therefore, the A1-toward orientation at the Plate Hub Carousel is not the optimal setup.

Related information

For information about...	See...
Teachpoint files	“Teachpoint files” on page 69
Setting teachpoints	“Setting Direct Drive Robot teachpoints” on page 69

Setting Direct Drive Robot teachpoints

About this topic

The BioCel System is set up with the correct teachpoints to enable the robot to move to the correct locations during a protocol run. You do not need to add or modify the existing teachpoint file unless you:

- Integrate a new device in the BioCel System.
- Move the BioCel System.
- Move or replace one of the devices in the system.
- Adjust settings on the devices.

Depending on the type of device, the teachpoint setting procedure can vary.

This topic provides basic teachpoint setting concepts: how to use the supplied teaching jig to set, verify, and edit Direct Drive Robot teachpoints. Always contact Automation Solutions Technical Support when you want to integrate a new device.

For information about device teachpoints, see the device user guide.

Teachpoint files

The teachpoints you set are saved in the XML format in a teachpoint file. The default teachpoint file name is Teachpoints_<profilename>.xml, where <profilename> is the name of the profile. The software saves the file in the C:\Program Files\Agilent Technologies\Settings\DDR folder. However, you can select another file name and location when saving the file.

CAUTION Always edit and manage teachpoints in the Robot Diagnostics software. Do not edit the teachpoint file (XML file) directly. Editing the file directly can cause the robot to move to incorrect locations and bump into devices or other obstacles.

You can have multiple teachpoint files for each BioCel System if a device needs to serve multiple purposes. For example, a platepad can be taught as a platepad or as a regripping station. You can also have multiple teachpoint files for the system if a device is only used in some protocols but not others. For example, if a device is installed on a mobile device table and can be removed when it is not in use.

CAUTION Before you begin changing teachpoints, make a backup copy of the teachpoint file. If the original file becomes lost or damaged, you can use the backup copy instead of reteaching all the positions.

The teachpoint file is referenced by a profile. For information about profiles, see “Creating and managing Direct Drive Robot profiles” on page 47.

Workflow

The workflow for setting a Direct Drive Robot teachpoint is as follows:

Step	For this task	See...
1	Install the teaching jig in the robot grippers. If size restrictions at teachpoints prevent the use of the teaching jig, use the labware intended for the location.	"Installing and removing the teaching jig in the robot grippers" on page 71 "Setting teachpoints using a labware" on page 88
2	Create a new teachpoint.	"Creating a new teachpoint" on page 74
3	Name the teachpoint.	"Naming the teachpoint" on page 74
4	Specify the A1-well orientation.	"Specifying the A1-well orientation" on page 74
5	*Optional.* Designate a teachpoint as a regrip station.	"Designating a teachpoint as a regrip station" on page 77
6	Set teachpoint parameters: • Set the approach height. • Set the approach distance. • Set the gripper offset range. • Fine-tune the teachpoint coordinates. • Select custom actions.	• "Setting the approach height" on page 80 • "Setting the approach distance" on page 81 • "Setting the gripper offset parameters" on page 83 • "Setting the Position Z, Waist, Elbow, and Wrist parameters" on page 84 • "Selecting custom actions" on page 84
7	Save the teachpoints.	"Saving the teachpoints" on page 85
8	*Optional.* Selecting the All regrip stations are safe from above option.	"Selecting the All regrip stations are safe from above option" on page 87

Before you start

Make sure:

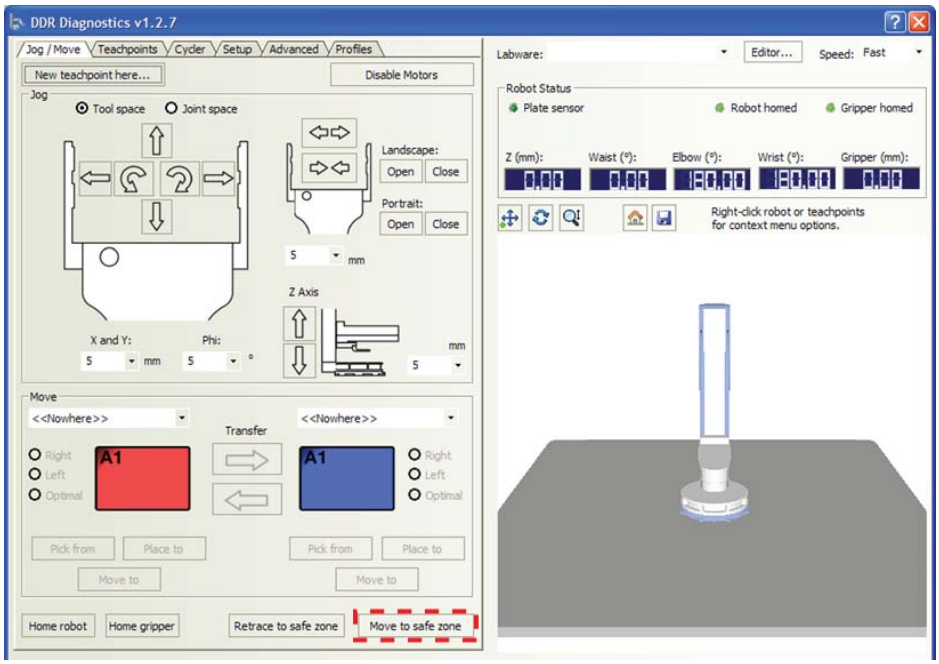
- You review the guidelines for setting teachpoints ("Planning Direct Drive Robot teachpoints" on page 60).
- You have the provided Direct Drive Robot teaching jig. If size restrictions at teachpoints prevent the use of the teaching jig, use the labware intended for the location. See "Setting teachpoints using a labware" on page 88.
- You have a 2-mm hex wrench for installing and removing the teaching jig.
- The correct profile is initialized ("Creating and managing Direct Drive Robot profiles" on page 47).
- The safety interlock is turned off ("Power panel" on page 7).

Installing and removing the teaching jig in the robot grippers

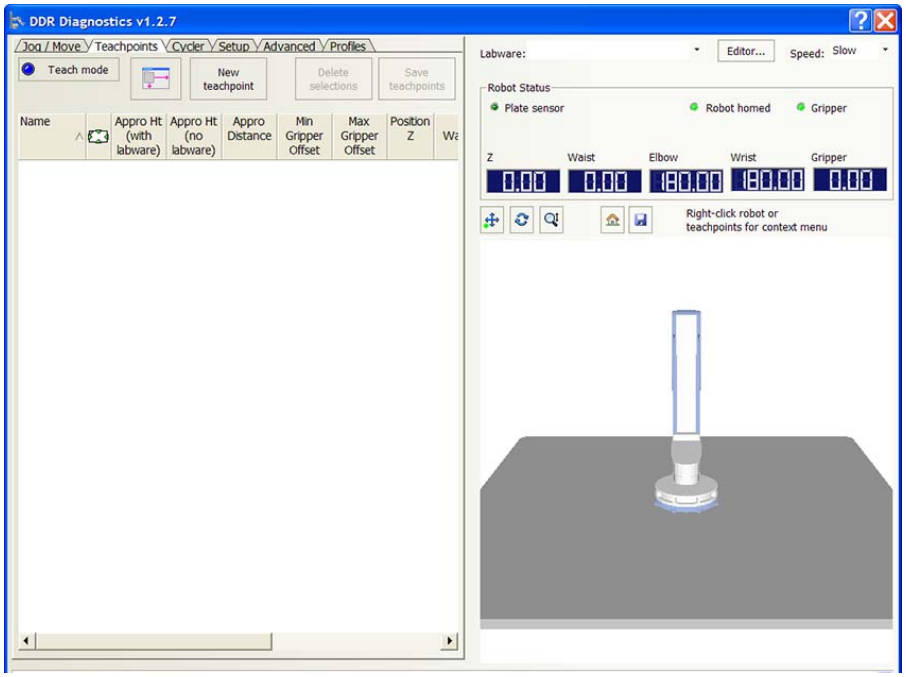
IMPORTANT If size restrictions at a teachpoint prevent the use of the teaching jig, use the labware intended for the location. For information, see "Setting teachpoints using a labware" on page 88.

To install the teaching jig:

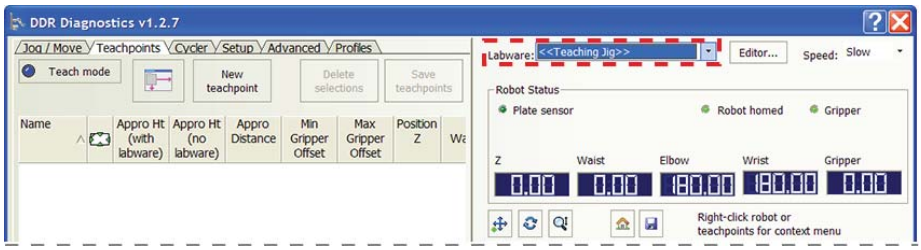
1 In **DDR Diagnostics,** click the **Jog/Move** tab, and then click **Move to safe zone.** The robot moves into its safe zone.



2 In **DDR Diagnostics,** click the **Teachpoints** tab.

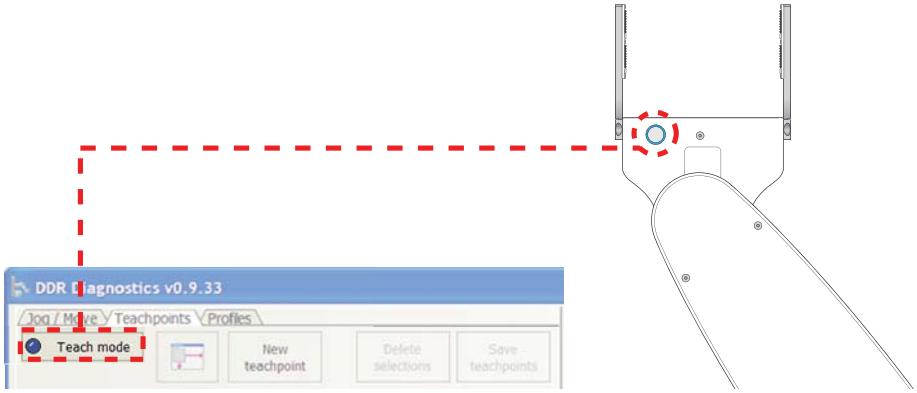


3 In the **Labware** list, select **Teaching jig.**



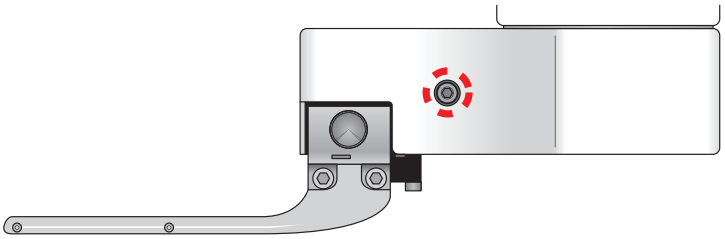
4 Click **Teach Mode.** The blue light on the robot hand turns on to indicate that it is in the teach mode. You should be able to move the robot arm without resistance.

IMPORTANT Always move the robot arm slowly when in the Teach Mode.

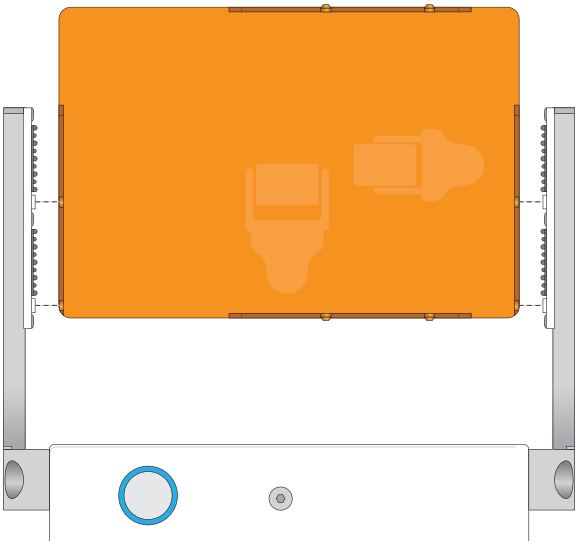


5 Manually move the robot arm to a position that will be convenient for you to install the teaching jig.

6 Using the 2-mm hex wrench, turn the gripper lead screw to open the robot grippers so that the teaching jig can fit in the grippers. You can access the lead screw from both sides of the robot hand.



7 Position the teaching jig between the robot grippers. Align the two pins on both sides of the teaching jig with the white dimples in the grippers. The following diagram shows the alignment positions in the landscape mode.



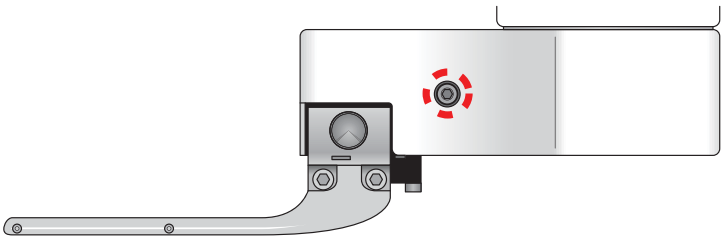
8 Using the 2-mm hex wrench, turn the gripper lead screw to close the robot grippers. The grippers should hold the teaching jig securely.

To remove the teaching jig:

1 While in the Teach Mode, manually move the robot arm to a position that will be convenient for you to remove the teaching jig. Make sure you move the robot slowly

2 Place a hand under the teaching jig to support its weight for the next step.

3 Using the 2-mm hex wrench, turn the gripper lead screw to open the robot grippers so that the teaching jig is free from the grippers.

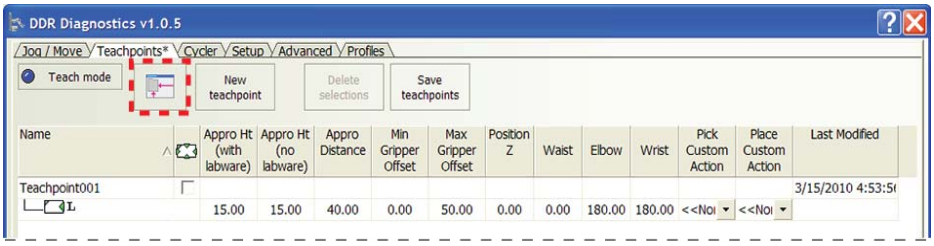


Creating a new teachpoint

To create a teachpoint:

1. With the teaching jig in the robot grippers, slowly move the robot arm to the desired location. When moving the robot arm:
   a. Check for potential obstacles near the location.
   b. Keep in mind the "Guidelines for setting teachpoints" on page 63.
2. Position the teaching jig at the desired location. Make sure the teaching jig sits flat at the location.
3. Press the blue button on the robot hand. The blue light flashes for a moment. In the Teachpoints tab, a new entry appears.

   Note: The blue light does not flash if the robot is at a location that is outside of its travel limits. Move the teachpoint location and try again.
4. To view the entire teachpoints table, click the (Maximize/Minimize) button. The table expands so that all of the columns are displayed in the tab.



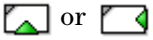
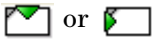
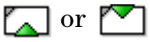
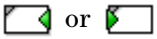
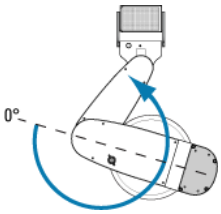
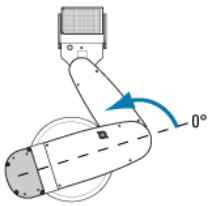
Naming the teachpoint

To name the teachpoint:

Double-click the **Name** box and type a new name for the teachpoint. Use a name that describes the location, such as the device name (for example, PlateLoc - 1).

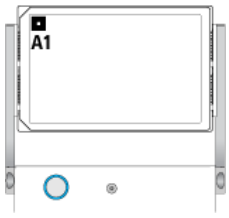
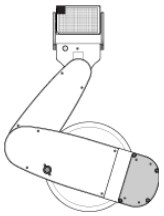
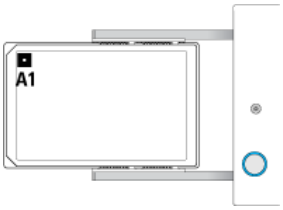
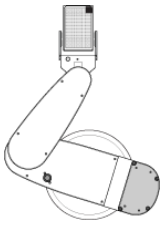
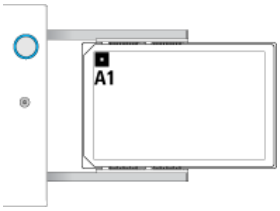
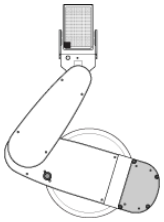
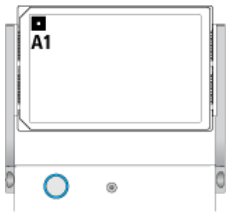
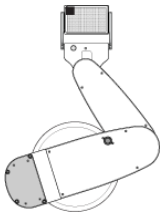
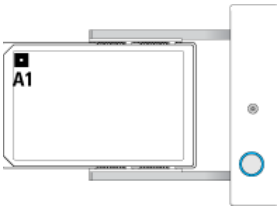
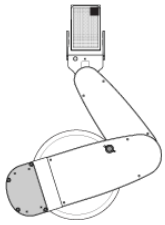
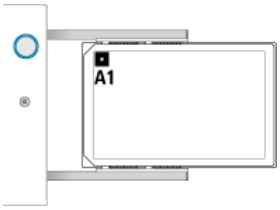
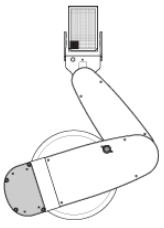
Specifying the A1-well orientation

The icon under the teachpoint name indicates the following:

Item	Description
1	A1-well orientation. From the robot's perspective, the A1 well (the gray corner on the icon) can be: • *Away from the robot grippers.*  or • *Toward the robot grippers.*  or The robot cannot detect the location of the A1 well. Therefore, you must provide this information in the software. ***To change the A1-well orientation:*** Double-click the icon. The robot gripper symbol (green triangle) moves to the opposite side of the labware. *Note:* The robot is unaware of the A1-well orientation assignment. Changing it in the software does not automatically or physically change the way the robot holds the labware.
2	Labware orientation. The location of the green robot gripper symbol determines the orientation: • *Landscape.*  or • *Portrait.*  or *Note:* You cannot change the labware orientation. The software uses the gripper width to determine whether it is in the landscape or portrait mode.
3	Robot-arm orientation: Left (L)  or right (R)  *Note:* You cannot change the robot arm orientation. The software uses the elbow joint angle to determine whether it is in the left- or right-arm mode. A right arm has an elbow joint angle < 180°. A left arm has an elbow joint angle of >= 180°.

Common orientations

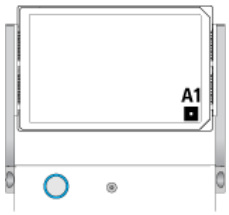
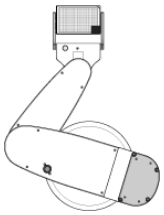
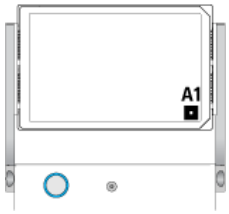
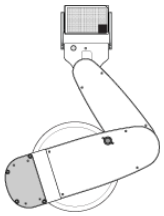
Eight orientations are possible for each teachpoint, based on different A1-well, labware, and robot-arm orientations. The following table presents six common orientations.

Orientation icon	Labware orientation	Robot arm orientation
L		
L		
L		
R		
R		
R		

Atypical orientations

The following table presents two atypical orientations. These orientations are used only when:

- Devices, such as the FLIPR Tetra device, require the A1 well to be toward the grippers.
- Two robots in the same system will use a single location to pass labware. One robot will approach the teachpoint using a common orientation (for example, landscape and A1 away), the other robot will approach the same teachpoint from the opposite side, using an atypical orientation (for example, landscape and A1 toward).

Orientation icon	Labware orientation	Robot arm orientation
		
		

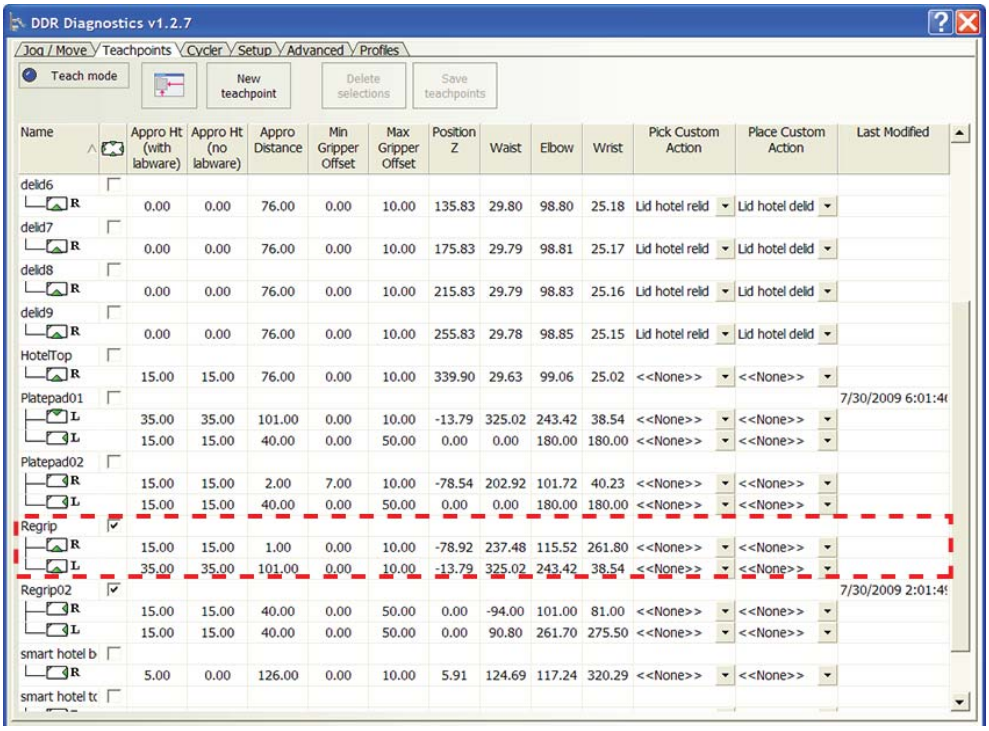
Designating a teachpoint as a regrip station

A regrip station is a location that enables the robot to:

- Change the labware orientation between teachpoints that require different orientations (landscape or portrait).
- Change A1-well orientation between teachpoints that require different A1-well orientations.
- Adjust its grip at the specified labware gripping height. The location is typically used after a robot picks up a labware higher than the specified gripping height because of physical restrictions at a teachpoint.

Note: Regrip stations cannot be used for other purposes such as deadlock avoidance.

To accommodate different labware orientations, add multiple orientations to the regrip teachpoint. In the following example, the Regrip teachpoint accommodates both the right- and left-arm orientations, with the landscape labware orientation and the A1 well away from the grippers.



To designate a teachpoint as a regrip station:

Select the **Regrip Station** check box.

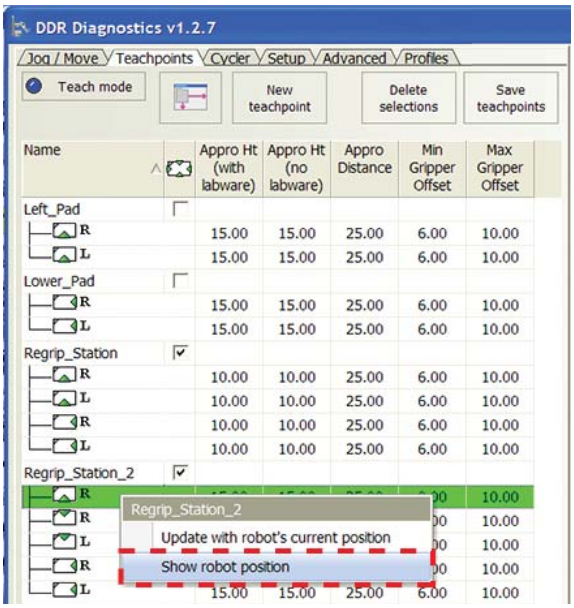
CAUTION Changes to a regrip station (from a regular teachpoint to a regrip station or from a regrip station to a regular teachpoint) are not applied until you save the teachpoint file.

To add additional orientations to the regrip teachpoint:

1. Create another teachpoint at the same location but with a different orientation. A new entry appears in the teachpoints table.
2. If necessary, set the A1-well orientation.

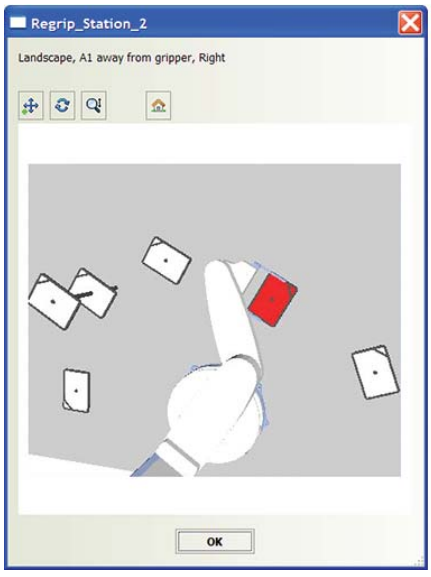
   By default, a new teachpoint will always have the A1-away orientation. When adding multiple teachpoints at a regrip station, if two of the teachpoints have the same labware and robot-arm orientation, and it is difficult to tell which one should have the A1-well away or toward assignment unless you see the actual robot position:

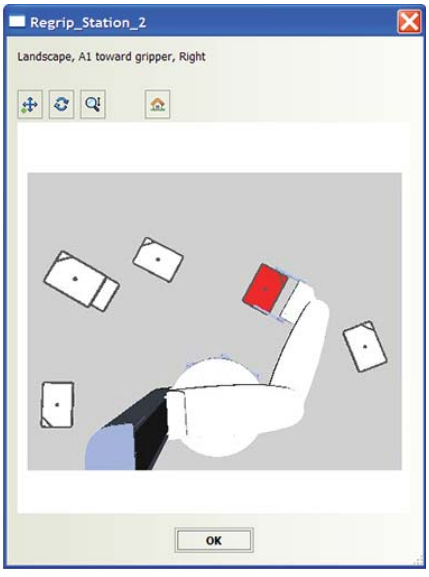
a Right-click the teachpoint in the teachpoints table, and then click **Show robot position.**



b In the dialog that appears, check the robot position, and the robot-arm and A1-well orientations.

In the following example, two teachpoints have the same labware and robot-arm orientations: landscape and right-arm. However, depending on the robot approach, the A1-well orientation will be different.





c Click **OK** to exit the dialog box and, if necessary, set or correct the A1-well orientation setting.

3 Drag the new teachpoint under an existing regrip teachpoint.

CAUTION The new teachpoint must have a different orientation than the existing regrip teachpoint. Otherwise, the software will prompt you to replace or reteach the existing teachpoint during the drag-and-drop operation.

4 Set the remaining teachpoint parameters.

Setting the approach height

Approach height is the height clearance, in millimeters, the robot must maintain above the teachpoint as it moves towards or away from the teachpoint.

- Approach Ht (with labware) is the height clearance when the robot is holding a labware.
- Approach Ht (no labware) is the height clearance when the robot is not holding labware.

You can reduce the approach height to prevent collision with shelves or other obstacles above the teachpoint. However, make sure there is sufficient clearance below the labware to prevent collision with raised tabs or other obstacles at the teachpoint.

CAUTION Incorrect approach heights can cause the robot to crash into obstacles.

IMPORTANT The approach height value works in conjunction with the approach distance to clear obstacles near or at the teachpoint. Therefore, before setting the approach height value, you should determine the approach distance value to use. See "Setting the approach distance" on page 81.

If Approach Distance is set at the default value:

- The Approach Ht (with labware) value should allow the robot and labware to arrive at the teachpoint without bumping into any obstacles, such as raised tabs, at the front of the teachpoint.
- The Approach Ht (no labware) value should allow the robot and its opened grippers to arrive at the teachpoint without bumping into any obstacles, such as raised tabs, at the sides of the teachpoint.

  Note: If the teachpoint does not have any obstacles on the front or sides, you can set Approach Ht (no labware) at 0. The robot will approach the teachpoint at the higher of the teachpoint or labware minimum gripper offset value.

If Approach Distance is less than the default value:

- The Approach Ht (with labware) value should allow the robot and labware to arrive at the teachpoint without bumping into obstacles, such as raised tabs, at the front and sides of the teachpoint.
- The Approach Ht (no labware) value should allow the robot and its opened grippers to arrive at the teachpoint without bumping into the tallest labware at the teachpoint.

In general, if a teachpoint has raised tabs only at the front of the teachpoint, the Approach Ht (with labware) value should be greater than the Approach Ht (no labware) value.

Agilent Technologies recommends the following Approach Ht (with labware) values:

Device	Approach Ht (with labware)
Most devices	9 mm
Vertical Pipettor shelf with tipbox	6 mm
Centrifuge	5.5 mm
Plate Hub Carousel Carousel or Plate Hotel with standard labware	5–6 mm
Lid Hotel Station	0 mm*
Vacuum Delid Station	0 mm*

* Required approach height for the device

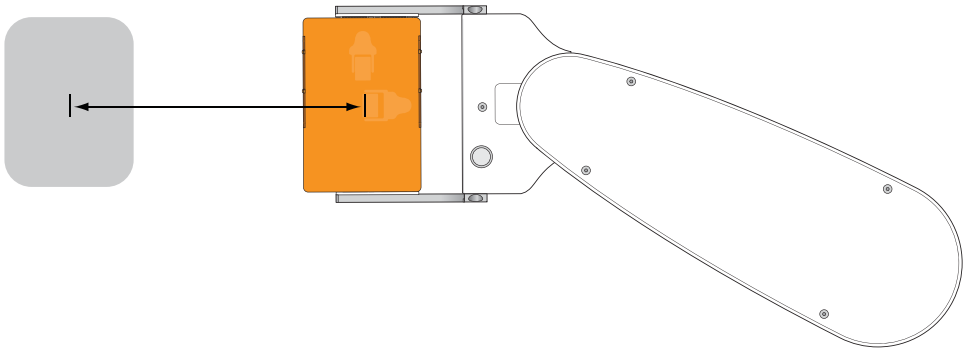
To set the Approach Ht (with labware) and Approach Ht (no labware) parameters:

Double-click in the **Approach Ht** box and type the desired value. The default value for both parameters is 15 mm.

Setting the approach distance

Approach distance is the distance, in millimeters, from the teachpoint. Within this distance, the robot must:

- Maintain the specified approach height.
- Move in a straight line toward or away from the teachpoint.



You use the approach distance to provide clearance:

- Between the teachpoint and the robot grippers.
- If the teachpoint has obstacles on either side of the teachpoint.

For example, you can use the approach distance parameter so that the robot grippers can enter and exit a device such as the Microplate Centrifuge without bumping into the sides of the narrow entryway.

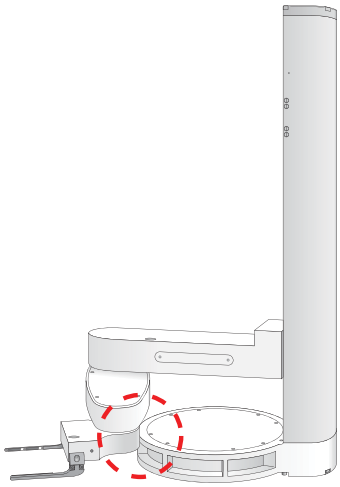
When determining the value to specify, manually move the robot away from the teachpoint until the grippers and the teaching jig are clear of the edge of the teachpoint and obstacles near the teachpoint.

In addition, consider the following:

- In general, if Approach Distance is set at the default value, you can use the default Approach Ht values.
- Rotating robot movements are faster than straight movements. If Approach Distance is set at 0, the robot will move (or mostly rotate) from the safe zone directly to the teachpoint at the Approach Ht.

  Before setting Approach Distance at 0, you should consider the obstacles surrounding and at the teachpoint. If obstacles near or at the teachpoint do not permit the rotating movement, set Approach Distance at the smallest possible value for the location.
- If Approach Distance is 0, Approach Ht (no labware) must be a higher value to ensure clearance for the tallest labware that will be placed at the teachpoint.
- If Approach Distance is greater than 0, Approach Ht can be low enough to clear raised tabs at the teachpoint.

CAUTION When setting Approach Distance, be aware that a large value can cause the robot arm to back into the raised robot base or the mast.



To set the Approach Distance parameter:

Double-click in the **Approach Distance** box and type the desired value. The default value is 75 mm for the landscape orientation and 125 mm for the portrait orientation.

Setting the gripper offset parameters

About gripper offset parameters

The robot gripper offset range parameters tell the Direct Drive Robot where to grip a given labware type when transferring it from one device to another. Each device within a system can pose different accessibility challenges when transferring the labware. For example, some devices can have a deep, recessed area, whereas others are more flat. Some devices might have tall flanges that make it impossible for the robot to grip a microplate at a very low point.

The Direct Drive Robot uses three types of gripper offset ranges to determine the most compatible grip position for the labware type:

1. *Gripper offset range for the labware*. Specified on the Direct Drive Robot tab in the Labware Editor for each labware definition.
2. *Gripper offset range for pick-location device*. Specified in the DDR Diagnostics software for a given device (device A).
3. *Gripper offset range for place-location device*. Specified in the DDR Diagnostics software for a given device (device B).

If the three gripper offset ranges overlap, the robot will use the smallest common gripper offset to perform a direct labware transfer from device A to device B without regripping the labware. If the three ranges do not overlap, the software attempts to plan a path through one or more regrip stations. If the robot cannot perform the transfer, an error message appears at the time of the requested labware transfer.

To provide the system with the greatest flexibility for identifying a grip position that works for all locations, you should set the widest possible range for each gripper offset parameter.
Note: To catch and correct potential labware transfer errors, Agilent Technologies recommends that you verify the teachpoints and perform a dry run.

Before you set the gripper offset parameters

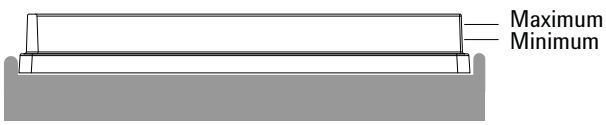
Under some circumstances, you should consider the gripper offset ranges of more than two teachpoints to avoid a regrip. For example, a labware will be delidded as it moves from the pick location (device A) to the place location (device B). In this case, the gripper offset range for the delid teachpoint must also overlap with the gripper offset range for the labware, device A, and device B.

Procedure

To set the Min gripper offset and the Max gripper offset parameters for a device:

Double-click the **Min gripper offset** and **Max gripper offset** box and type the desired values:

- *Minimum gripper offset*. The vertical distance (mm) from the teachpoint to the lowest point where the robot grippers can hold the microplate securely. The default value is 0 mm.
- *Maximum gripper offset*. The vertical distance (mm) from the teachpoint to the highest point where the robot grippers can hold the microplate securely. The default value is 10 mm.



IMPORTANT For regrip stations, make sure the gripper offset range can accommodate all types of labware.

Setting the Position Z, Waist, Elbow, and Wrist parameters

CAUTION In general, you do not need to change any of the coordinates after setting a teachpoint.

If necessary, you can fine-tune the teachpoint coordinates using the following parameters:

- *Position Z*. The *z*-axis coordinate of the robot, measured in millimeters.
- *Waist*. The waist joint coordinate.
- *Elbow*. The elbow joint coordinate.
- *Wrist*. The wrist joint coordinate.

To set a coordinate parameter:

Double-click in the **Position Z**, **Waist**, **Elbow**, and **Wrist** box and type the desired value.

Note: You can also use the jog method when fine-tuning. For instructions, see "Editing existing Direct Drive Robot teachpoints" on page 102.

Selecting custom actions

Custom actions are special pick-and-place actions that the robot will perform after it arrives at the teachpoint. The set of custom actions include:

- Delidding at a Lid Hotel Station or a Vacuum Delid Station
- Relidding at a Lid Hotel Station
- Stirring the labware
- Pressing down a labware (for example, PCR plate) to ensure placement

You can select a custom action for when the robot picks up the labware or when it places the labware.

To select a custom action for a teachpoint:

1 Select the appropriate custom action from the **Pick Custom Action** list.

Use the Pick Custom Action to:

- Relid labware at the Lid Hotel Station. From the **Pick Custom Action** list, select **Lid Hotel relid.**

  Note: You can select a custom action for each storage bay in the Lid Hotel Station. Do not assign a custom action for the platepad at the top of the station.
- Stir the labware at the teachpoint. From the **Pick Custom Action** list, select **Stir.**

2 Select the appropriate custom action from the **Place Custom Action** list.

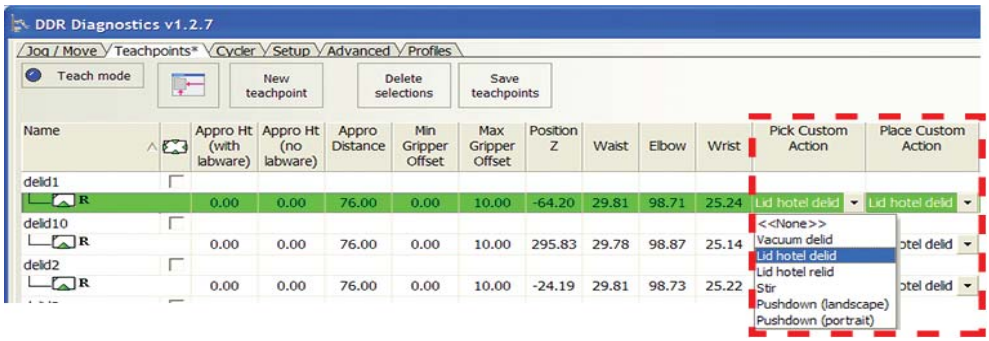
Use the Place Custom Action to:

- Delid labware at the Lid Hotel Station or the Vacuum Delid Station. From the **Place Custom Action** list, select either **Lid Hotel delid** or **Vacuum delid.**

  Note: You can select a custom action for each storage bay in the Lid Hotel Station. Do not assign a custom action for the platepad at the top of the station.

- Press down labware, such as a PCR plate, when the robot is placing the labware. During the place action, the robot will press down by 2 mm, open the grippers to release the labware, and then move up by 2 mm.

  From the **Place Custom Action** list, select either **Pushdown (landscape)** or **Pushdown (portrait).**



Saving the teachpoints

The teachpoint information is stored in:

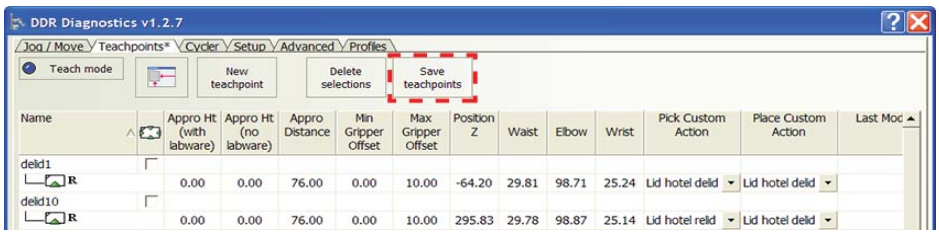
- The teachpoints file on the controlling computer
- The robot firmware

When you create or modify teachpoints without saving them, the changes are kept in computer memory only. Saving the teachpoints in DDR Diagnostics updates the teachpoints file and the information in the firmware.

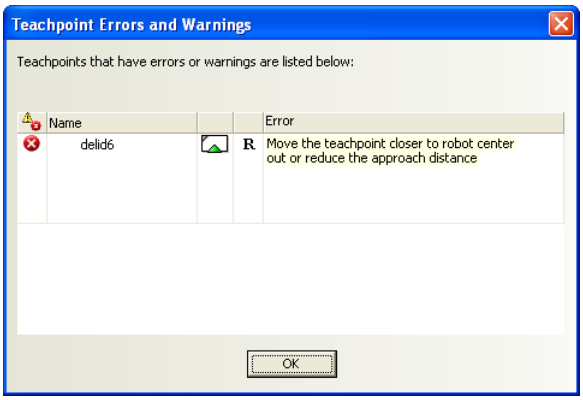
Note: Saving teachpoints adds new teachpoints or updates only those teachpoints that have been modified in DDR Diagnostics. Saving teachpoints does not overwrite all of the existing teachpoints. For example, a teachpoint file contains teachpoints A and B. You modify teachpoint B and add teachpoint C. When you save the teachpoints, teachpoint C is added, and teachpoint B is updated. Teachpoint A is not touched.

To save the teachpoints:

1 Click **Save teachpoints.**

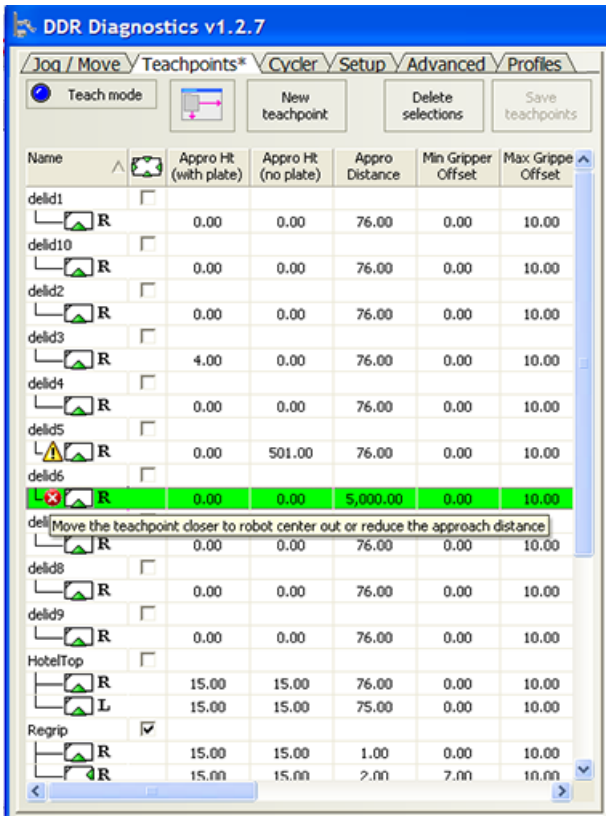


If there are any errors or warnings, such as an out-of-bounds parameter value, the software will list them in the Teachpoint Errors and Warnings dialog box.



2 Click **OK** to close the dialog box and return to the teachpoints table. Notice that error and warning symbols appear in the teachpoints table.

3 To display the error or warning message, rest the pointer on the error or warning symbol.



4 Fix the errors, and then click **Save teachpoints.**

Be sure to remove the teaching jig from the robot grippers when you are finished. See “Installing and removing the teaching jig in the robot grippers” on page 71.

Selecting the All regrip stations are safe from above option

The **All regrip stations are safe from above** option enables the robot to rotate its wrist above the regrip station while it prepares to change labware orientation.

If the option is selected, the robot will place the labware at the regrip station, lift its arm to the specified Approach Ht (no labware) distance above the regrip station, rotate its wrist, and then pick up the labware using the new orientation. The robot does not retreat into the safe zone during this process.

If the option is not selected, the robot will place the labware at the regrip station, retreat into the safe zone, and then pick up the labware at the regrip station using the new labware orientation. The specified Approach Ht and Approach Distance values are used during the retreat and pickup movements.

After you have finished setting all the teachpoints, review the list in the teachpoints table. You can select the **All regrip stations are safe from above** option in the Profiles tab if:

- There is at least one regrip station that is used to change labware orientations.
- There is sufficient clearance above *all* regrip stations to permit the robot to rotate its wrist during a labware orientation regrip process.

To see where you select this option in the Profiles tab, see "Creating a Direct Drive Robot profile" on page 48.

Related information

For information about...	See...
Robot Diagnostics	• "Software description" on page 24 • "DDR Diagnostics" on page 206
Direct Drive Robot axes	"Direct Drive Robot" on page 15
Quick reference of DDR Diagnostics commands and parameters	"Quick reference" on page 355

Setting teachpoints using a labware

When to use labware instead of the teaching jig

In cases where size restriction at a teachpoint prevents the use of the teaching jig, you can use the labware intended for the location.

Procedure

To use a labware in the teaching procedure:

1 Teach a reference location, such as Platepad 1, using the teaching jig.

IMPORTANT When teaching the reference location, make sure the Min gripper offset parameter value is less than or equal to the minimum gripper offset value specified for the labware in the Labware Editor.

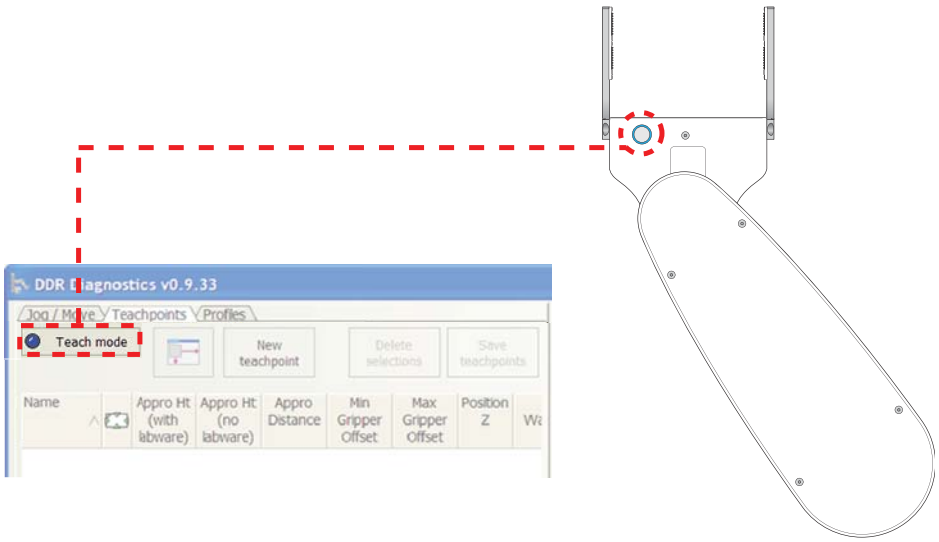
CAUTION When using a labware to set teachpoints, the software assumes that the robot is holding the labware at the minimum gripper offset.

2 Verify the Platepad 1 teachpoint.

3 Place the desired labware at Platepad 1.

4 Follow the instructions in "Picking up labware at the teachpoint" on page 93 to pick up the labware from Platepad 1.

5 In DDR Diagnostics, click **Teach Mode.** The blue light on the robot hand turns on to indicate that it is in the teach mode. You should be able to move the robot arm without resistance. Make sure you move the robot slowly.



6 Follow the instructions in "Creating a new teachpoint" on page 74 to create a new teachpoint.

7 Set the teachpoint parameters.

8 Save the teachpoint.

9 Verify and edit the teachpoint.

Related information

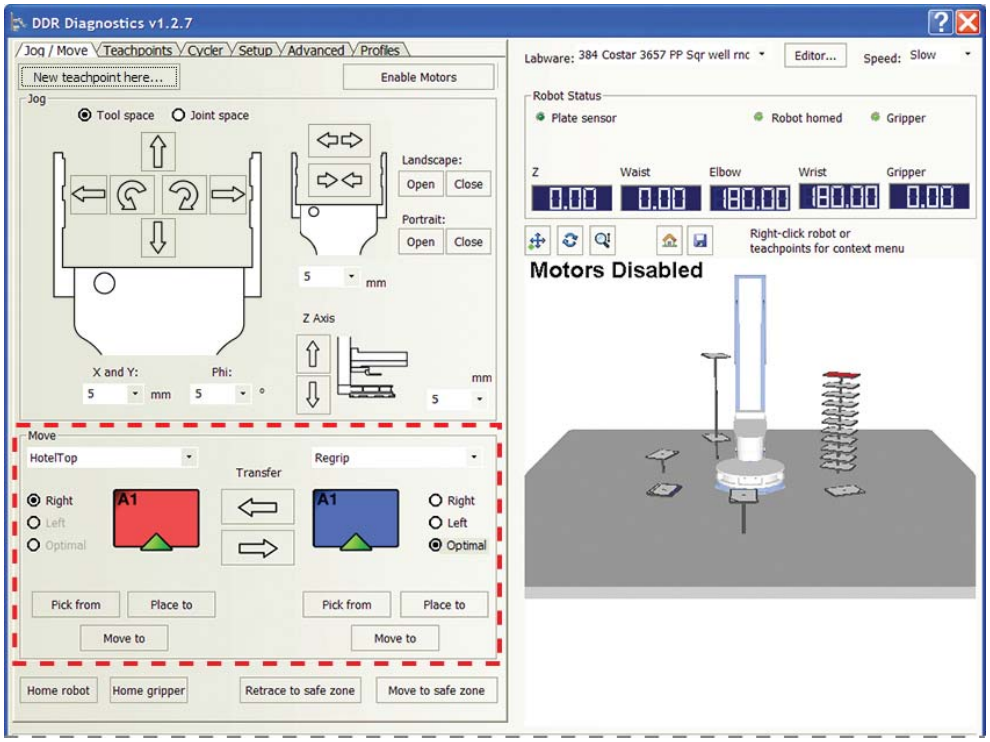
For information about...	See...
Workflow for setting teachpoints	"Workflow" on page 70
Using other commands and parameters in the DDR Diagnostics	"DDR Diagnostics" on page 206
Quick reference of DDR Diagnostics commands and parameters	"Quick reference" on page 355

Verifying Direct Drive Robot teachpoints

After you set a new teachpoint, you should verify that it is accurate. During the verification procedure, you will check that the robot is able to:

- Go to the teachpoint from its current location.
- Pick up labware at the teachpoint.
- Place labware at the teachpoint.
- Transfer labware from another teachpoint to this teachpoint.

You use the commands in the **Jog/Move** tab for the verification procedure.



Moving the robot to the new teachpoint

You use the **Move to** command to check that:

- The robot is able to move to the selected teachpoint.
- The approach orientation at the teachpoint is correct.

To move the robot to the teachpoint:

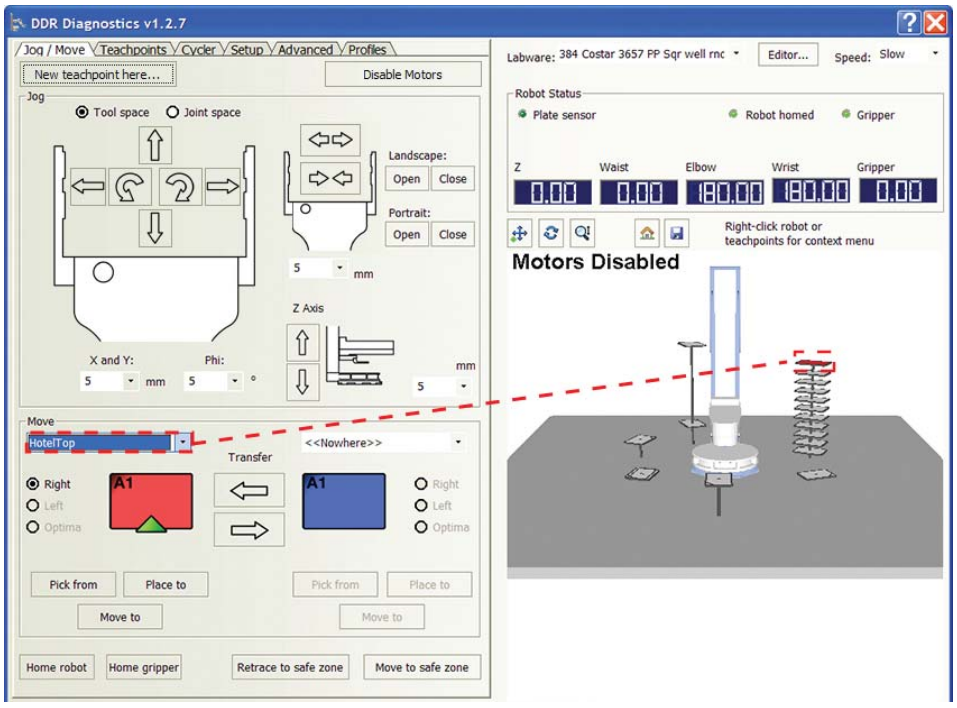
1. Make sure the robot has a clear path to the teachpoint. For example, you might want to move the robot into the safe zone.
2. Remove obstacles in the path of the robot.
3. In **DDR Diagnostics,** make sure the correct labware is selected in the **Labware** list.

4 In the **Speed** list, select **Slow.**

5 Click the **Jog/Move** tab, and, if necessary, click **Enable Motors** to enable the robot motors.

6 In the **Move** area, select the teachpoint you want to verify from the list above the red labware. In the Robot Status area, the selected teachpoint turns red.

In the following example, the HotelTop teachpoint is selected. In the Robot Status area, the teachpoint at the top of the Plate Hotel becomes red.



7 If you selected a teachpoint with multiple orientations, such as a regrip station, select the specific set of orientations you want to verify.

Note: By default, all orientations defined for the teachpoint are selected.

- If multiple labware orientations are available, make sure only one orientation is selected. Click a triangle to select or clear the orientation selection. A green triangle means the orientation is selected. A white triangle means the orientation is not selected.

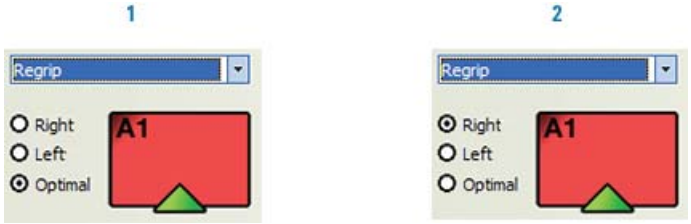
  In the following example, three labware orientations are available: Landscape with the A1 well away from the grippers, landscape with the A1 well toward the grippers, and portrait with the A1 well away from the grippers (1). For the verification procedure, only one orientation is selected: Landscape with the A1 well away from the grippers (2).

1 2

- If the Optimal orientation is selected to indicate that both the right-arm and left-arm orientations are available, select **Right** or **Left**.

  In the following example, the Regrip station allows for both the right- and left-arm orientations (1). To verify the right-arm orientation, Right is selected (2).

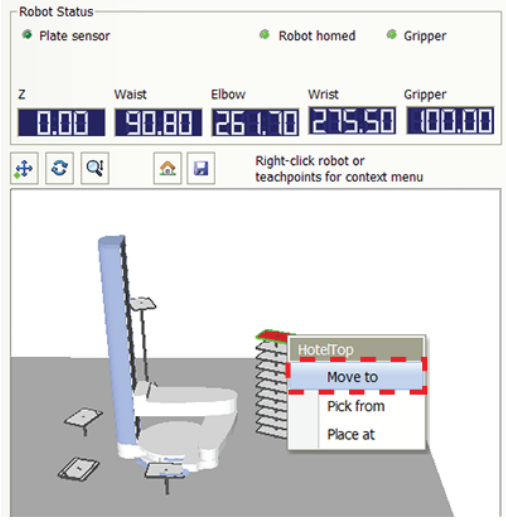
1 2



Agilent Technologies recommends that you verify one set of orientations at a time. If multiple sets of orientations are selected, the robot will use the optimal path.

8 In the **Move** area, click **Move to** under the red labware.

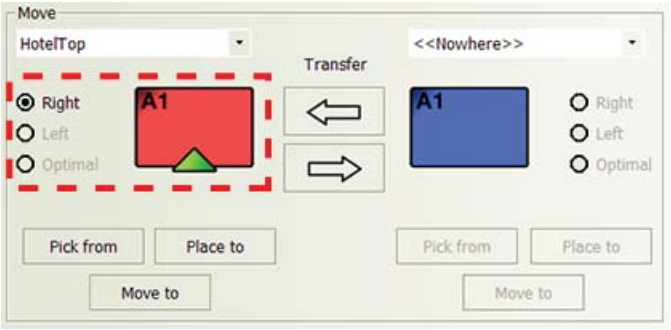
Alternatively, you can right-click the red teachpoint in the **Robot Status** area, and then click **Move to.**



The robot moves to the selected teachpoint. The robot remains at the teachpoint and the grippers are open.

9 Check that the robot used the correct approach distance and approach height. In addition, make sure the robot is in the correct orientation as shown in the Move area.

In the following example, the robot should be in the right-arm mode and the grippers should be opened as if it was transferring a labware in the landscape orientation.



10 To make adjustments, proceed to "Editing existing Direct Drive Robot teachpoints" on page 102.

11 Repeat the procedure for another teachpoint. If you are verifying a teachpoint with multiple orientations, be sure to verify each orientation before checking another teachpoint.

Picking up labware at the teachpoint

You use the **Pick from** command to check that:

- The robot is using the correct approach distance and approach height as it moves to and from the teachpoint.
- The robot is able to pick up labware at the selected teachpoint.
- The robot picks up the labware within the specified gripper offset range.

To pick up labware from the teachpoint:

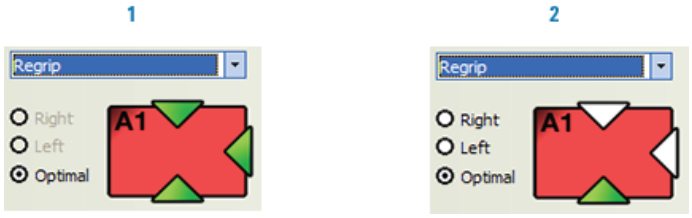
1. Make sure the robot has a clear path to the teachpoint. For example, you might want to move the robot into the safe zone.
2. Remove obstacles in the path of the robot.
3. Manually place the labware at the teachpoint.
4. In **DDR Diagnostics,** select the labware you want to use from the **Labware** list.

5. In the **Speed** list, select **Slow.**
6. In the **Move** area, select the teachpoint you want to verify from the list above the red labware. In the Robot Status area, the selected teachpoint turns red.
7. If you selected a teachpoint with multiple orientations, such as a regrip station, select the specific set of orientations you want to verify.

   Note: By default, all orientations defined for the teachpoint are selected.

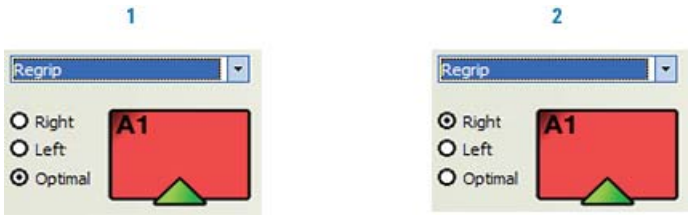
   - If multiple labware orientations are available, make sure only one orientation is selected. Click a triangle to select or clear the orientation selection. A green triangle means the orientation is selected. A white triangle means the orientation is not selected.

     In the following example, three labware orientations are available: Landscape with the A1 well away from the grippers, landscape with the A1 well toward the grippers, and portrait with the A1 well away from the grippers (1). For the verification procedure, only one orientation is selected: Landscape with the A1 well away from the grippers (2).



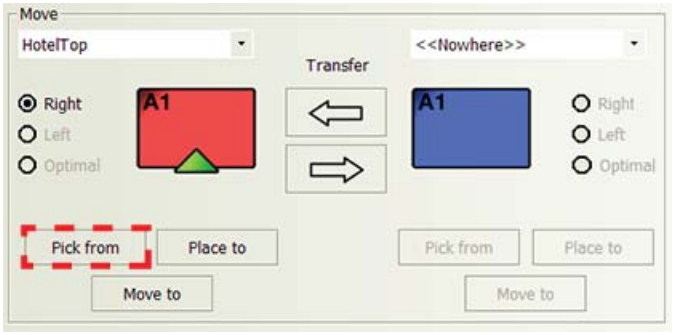
   - If the Optimal orientation is selected to indicate that both the right-arm and left-arm orientations are available, select **Right** or **Left**.

     In the following example, the Regrip station allows for both the right- and left-arm orientations (1). To verify the right-arm orientation, Right is selected (2).

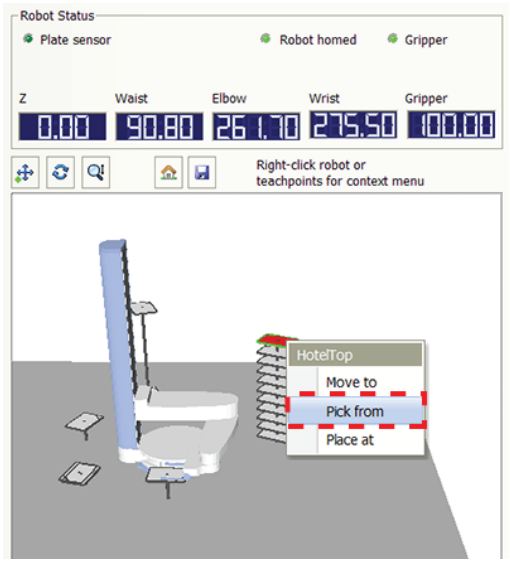


Agilent Technologies recommends that you verify one set of orientations at a time. If multiple sets of orientations are selected, the robot will use the optimal path.

8 In the **Move** area, click **Pick from** under the red labware.



Alternatively, you can right-click the red teachpoint in the **Robot Status** area, and then click **Pick from.**



The robot moves to the teachpoint, picks up the labware, and moves it to the safe zone. The labware remains in the robot grippers.

9 Check that the robot used the correct approach distance and approach height when picking up the labware. Also check that the robot is holding the labware within the specified gripper offset range.

10 To make adjustments, proceed to "Editing existing Direct Drive Robot teachpoints" on page 102.

11 If the robot has completed its task correctly, repeat the procedure for another teachpoint. If you are verifying a teachpoint with multiple orientations, be sure to verify each orientation before checking another teachpoint.

Placing labware at the teachpoint

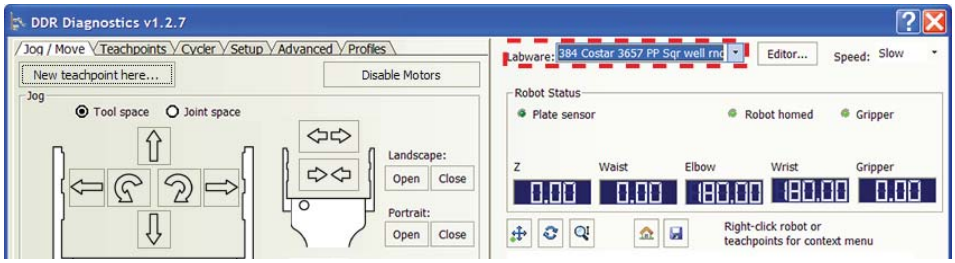
You use the **Place to** command to check that:

- The robot is using the correct approach distance and approach height as it moves to and from the teachpoint.
- The robot is able to place the selected labware at the selected teachpoint.

IMPORTANT To use the Place to command, you must first use the Pick from command to pick up a labware so that the gripper offset is known.

To place labware at the teachpoint:

1. Make sure the robot has a clear path to the teachpoint. For example, you might want to move the robot into the safe zone.
2. Remove obstacles in the path of the robot.
3. Make sure the robot is still holding the labware from the previous procedure ("Picking up labware at the teachpoint" on page 93).
4. In **DDR Diagnostics,** make sure the correct labware is selected in the **Labware** list.



5. In the **Speed** list, select **Slow.**
6. In the **Move** area, select the teachpoint you want to verify from the list above the red labware. In the Robot Status area, the selected teachpoint turns red.

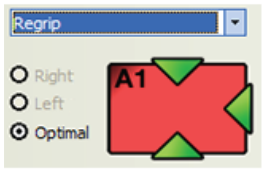
   Note: Alternatively, you can select the teachpoint under the blue labware. In the Robot Status area, the selected teachpoint turns blue.
7. If you selected a teachpoint with multiple orientations, such as a regrip station, select the specific set of orientations you want to verify.

   Note: By default, all orientations defined for the teachpoint are selected.

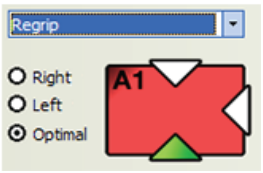
   - If multiple labware orientations are available, make sure only one orientation is selected. Click a triangle to select or clear the orientation selection. A green triangle means the orientation is selected. A white triangle means the orientation is not selected.

In the following example, three labware orientations are available: Landscape with the A1 well away from the grippers, landscape with the A1 well toward the grippers, and portrait with the A1 well away from the grippers (1). For the verification procedure, only one orientation is selected: Landscape with the A1 well away from the grippers (2).

1



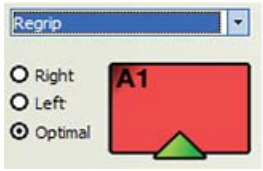
2



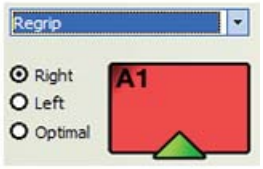
- If the Optimal orientation is selected to indicate that both the right-arm and left-arm orientations are available, select **Right** or **Left**.

  In the following example, the Regrip station allows for both the right- and left-arm orientations (1). To verify the right-arm orientation, Right is selected (2).

1

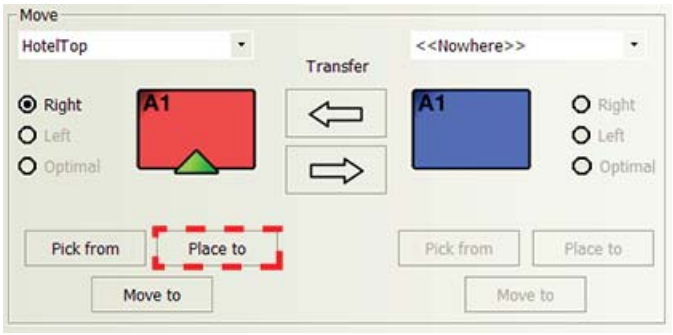


2

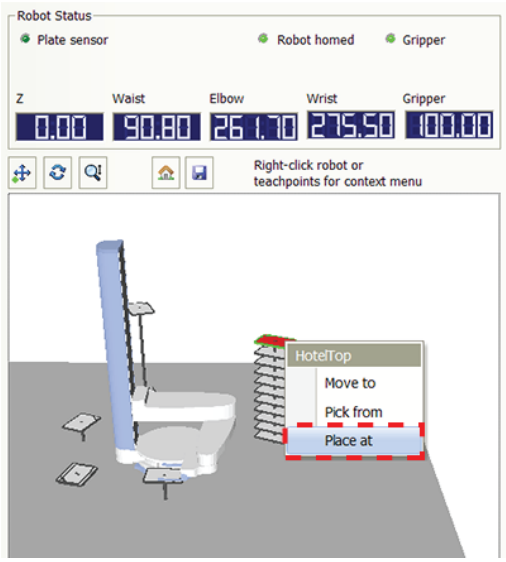


Agilent Technologies recommends that you verify one set of orientations at a time. If multiple sets of orientations are selected, the robot will use the optimal path.

8 In the **Move** area, click **Place to** under the red labware.



Alternatively, you can right-click the red teachpoint in the **Robot Status** area, and then click **Place at.**



With the labware in its grippers, the robot moves to the teachpoint, places the labware, and retreats to the safe zone.

9 Check that the robot used the correct approach distance and approach height when placing the labware. Also, check that the robot seated the labware correctly at the teachpoint. The robot should not drop the labware, and the labware should be centered at the teachpoint.

10 To make adjustments, proceed to "Editing existing Direct Drive Robot teachpoints" on page 102.

11 Repeat the procedure for another teachpoint. If you are verifying a teachpoint with multiple orientations, be sure to verify each orientation before checking another teachpoint.

Transferring labware between teachpoints

To ensure that a new teachpoint is accurate, check that the robot is able to transfer labware between the new teachpoint and an existing verified teachpoint. Incorrectly placed labware indicates that the teachpoint coordinates are incorrect.

To transfer labware from an existing verified teachpoint:

1 Make sure the robot has a clear path to the teachpoint. For example, you might want to move the robot into the safe zone.

2 Remove obstacles in the path of the robot.

3 Manually place the desired labware at the existing verified teachpoint (for example, platepad 1).

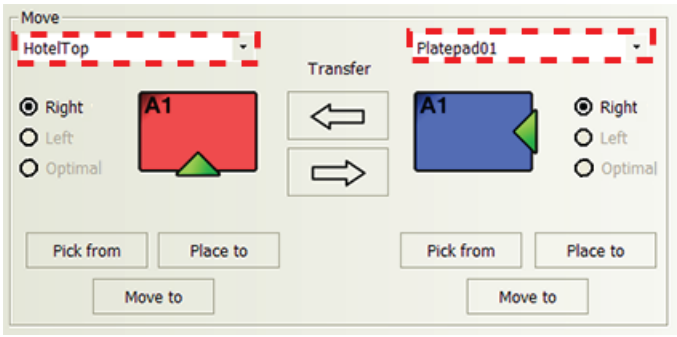
4 In **DDR Diagnostics,** select the labware you want to use from the **Labware** list.

5 In the **Speed** list, select **Slow.**

6 In the **Move** area:

a Select the teachpoint you want to verify from the list above the red labware. In the Robot Status area, the selected teachpoint turns red.

b Select the existing verified teachpoint (for example, platepad 1) from the list above the blue labware. In the Robot Status area, the selected teachpoint turns blue.

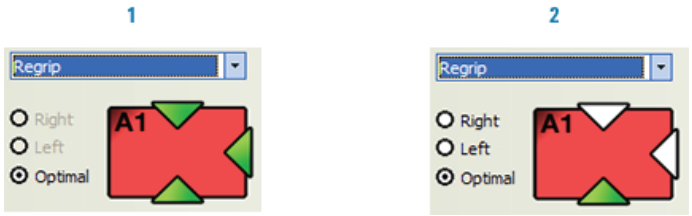


7 If you selected a teachpoint with multiple orientations, such as a regrip station, select the specific set of orientations you want to verify.

Note: By default, all orientations defined for the teachpoint are selected.

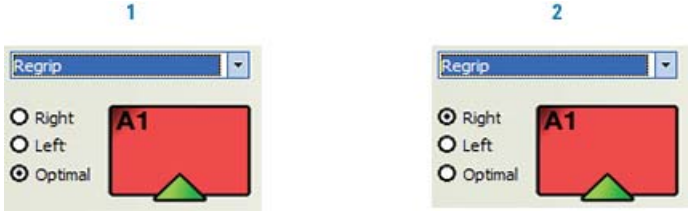
- If multiple labware orientations are available, make sure only one orientation is selected. Click a triangle to select or clear the orientation selection. A green triangle means the orientation is selected. A white triangle means the orientation is not selected.

  In the following example, three labware orientations are available: Landscape with the A1 well away from the grippers, landscape with the A1 well toward the grippers, and portrait with the A1 well away from the grippers (1). For the verification procedure, only one orientation is selected: Landscape with the A1 well away from the grippers (2).



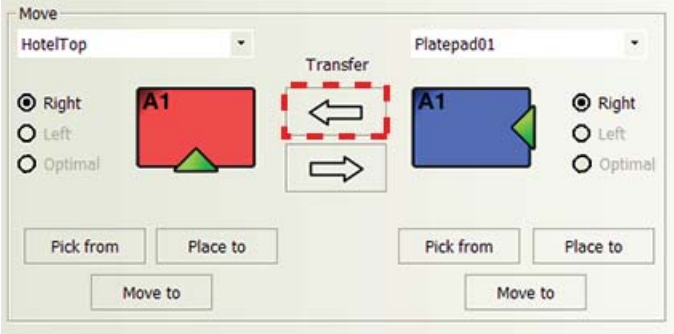
- If the Optimal orientation is selected to indicate that both the right-arm and left-arm orientations are available, select **Right** or **Left**.

  In the following example, the Regrip station allows for both the right- and left-arm orientations (1). To verify the right-arm orientation, Right is selected (2).

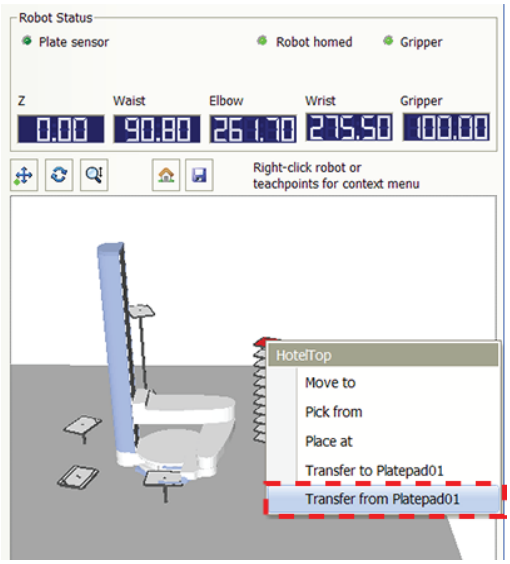


Agilent Technologies recommends that you first verify one set of orientations at a time first. After checking each set of orientations, select **Optimal** to check the optimal path the robot selects.

8 In the **Move** area, click the left-arrow **Transfer** button.



Alternatively, you can right-click the red teachpoint in the **Robot Status** area, and then click **Transfer from <teachpoint_name>.**



The robot picks up the labware at the reference teachpoint, places it at the teachpoint you want to verify, and retreats into the safe zone.

9 Check that the robot seated the labware correctly at the new teachpoint. The robot should not drop the labware, and the labware should be centered at the teachpoint.

Note: If the labware, pick-location, and place-location gripper offset ranges do not overlap, the software will display an error message when you attempt to transfer labware from teachpoint to teachpoint. Correct the error, and then try to transfer the labware again.

10 To make adjustments, proceed to "Editing existing Direct Drive Robot teachpoints" on page 102.

11 Repeat the procedure for another teachpoint. If you are verifying a teachpoint with multiple orientations, be sure to verify each orientation before checking another teachpoint.

As a final check:

- Repeat the transfer procedure at the **Fast** robot speed. At step 5, select **Fast**.
- Transfer labware between any two teachpoints. Check for the number of regrips between teachpoints. Remember that the goal is to minimize the number of regrips during transfers.

Related information

For information about...	See...
Planning Direct Drive Robot teachpoints	"Planning Direct Drive Robot teachpoints" on page 60
Using other commands and parameters in the Direct Drive Robot Diagnostics	"DDR Diagnostics" on page 206
Quick reference of DDR Diagnostics commands and parameters	"Quick reference" on page 355

Editing existing Direct Drive Robot teachpoints

When you set a teachpoint for the first time, you might set, verify, and edit the teachpoint to make sure the teachpoint is correct. After the teachpoint is set up correctly, you will not need to adjust or redefine it unless you do the following:

- Move the BioCel System.
- Move or replace one of the devices in the system, such as the robot.
- Adjust settings on the devices.
- Continue to use a robot that has unevenly worn gripper pads.
- Replace the robot gripper pads.

You can edit a teachpoint in one of two ways:

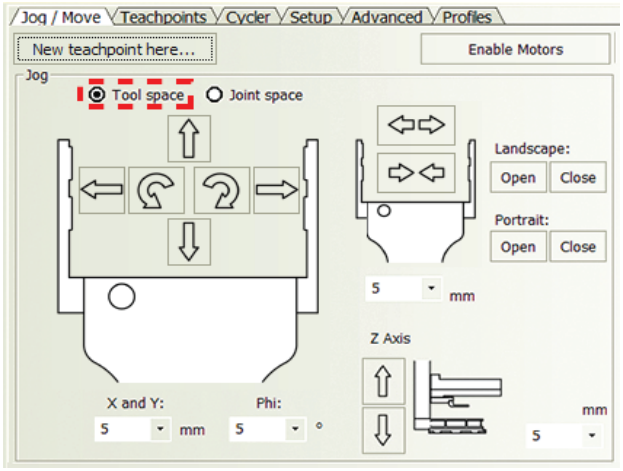
- Adjust the existing teachpoint location by jogging the robot in small increments.
- Replace the existing teachpoint with a new teachpoint.

Adjusting the existing teachpoint

Agilent Technologies recommends that you use the teaching jig when adjusting teachpoints.

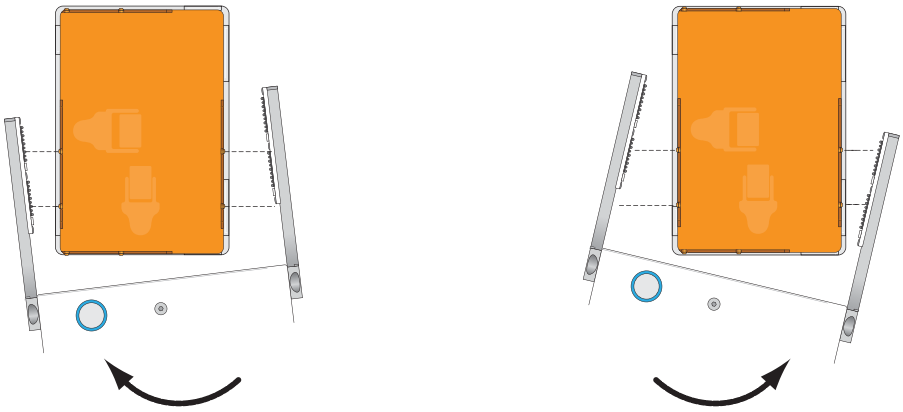
To adjust a teachpoint:

1. Make sure you have followed the procedure in "Verifying Direct Drive Robot teachpoints" on page 90 to determine the adjustments that you need to make to the teachpoint. For example, the robot is currently too far to the left of the teachpoint.
2. Manually place the teaching jig at the teachpoint.
3. In **DDR Diagnostics,** click the **Jog/Move** tab, and then select **Tool space.**

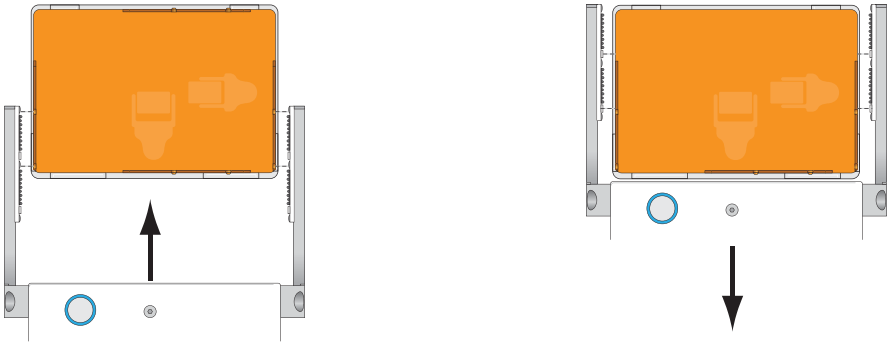


4. In the **Move** area, select the teachpoint you want to adjust, and then click **Move to.** The robot moves to the selected teachpoint. The robot remains at the teachpoint and the grippers are open.
5. Check the position of the robot grippers and the teaching jig. The two pins on both sides of the teaching jig should align with the white dimples in the grippers.

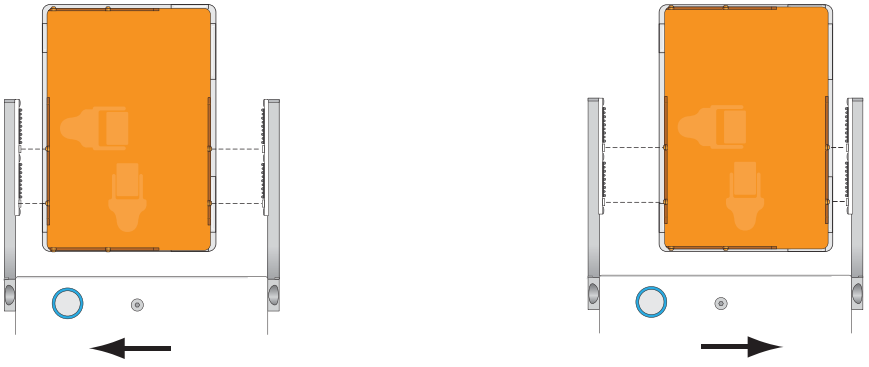
6 If the distances between two adjacent pin-dimple pairs are not the same, make rotational adjustments. In **Tool space,** rotate the robot in small increments along the *Phi*-axis. You can also go into **Joint space** to make rotational adjustments.



7 If the dimples on the robot grippers are farther out or closer than the pins on the teaching jig (as shown in the following diagram), in **Tool space,** jog the robot in small increments along the y-axis.

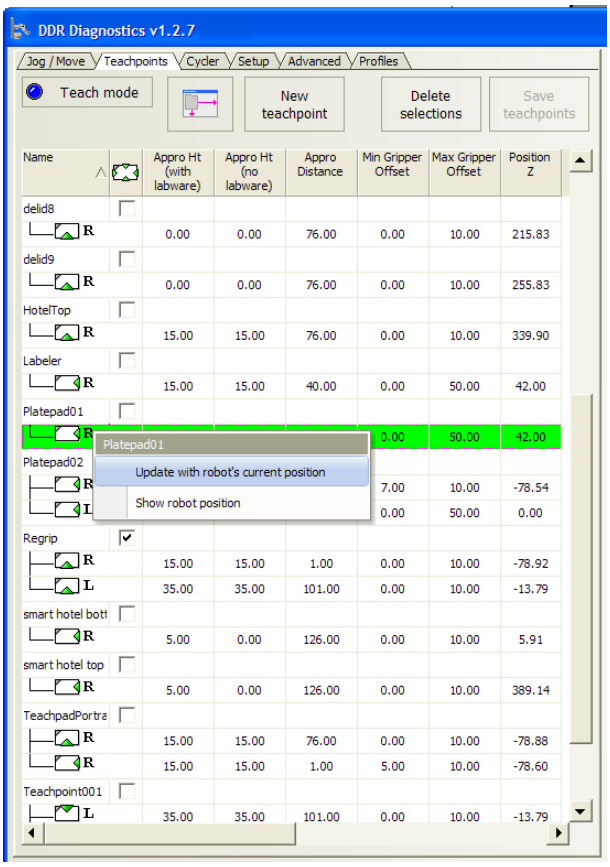


8 If the pin-dimple pairs on one side of the teachpoint are closer or farther than the pairs on the other side (as shown in the following diagram), in **Tool space,** jog the robot in small increments along the x-axis.



9 If the dimples on the grippers are higher or lower than the pins on the teaching jig, decrease or increase the z-axis value.

10 In the **DDR Diagnostics Teachpoints** tab, right-click the orientation icon of the teachpoint you are editing, and select **Update with robot's current position.** The teachpoint coordinates are updated.



11 Click **Save teachpoints.**

12 Return to "Verifying Direct Drive Robot teachpoints" on page 90 to verify the revised teachpoint.

Replacing the existing teachpoint

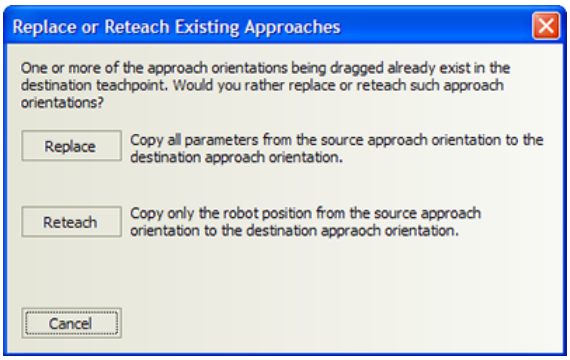
CAUTION The replacement procedure also replaces all the teachpoint parameter values such as the approach height and approach distance.

To replace an existing teachpoint:

1 Create a new teachpoint. See "Creating a new teachpoint" on page 74.

2 Set all the parameters for the teachpoint.

3 Drag the new teachpoint and drop it on the existing teachpoint. The Replace or Reteach Existing Approaches dialog opens.


Replace or Reteach Existing Approaches
One or more of the approach orientations being dragged already exist in the destination teachpoint. Would you rather replace or reteach such approach orientations?
Replace
Copy all parameters from the source approach orientation to the destination approach orientation.
Reteach
Copy only the robot position from the source approach orientation to the destination appraoch orientation.
Cancel

4 Click **Replace.** The existing teachpoint and its parameter values are replaced.

Related information

For information about...	See...
DDR Diagnostics	“Software description” on page 24
Tool space	“Jogging the Direct Drive Robot” on page 214
Using other commands and parameters in the DDR Diagnostics	“DDR Diagnostics” on page 206
Quick reference of DDR Diagnostics commands and parameters	“Quick reference” on page 355

Managing Direct Drive Robot teachpoints

You can rename, copy, or delete existing teachpoints.

Renaming teachpoints

To rename a teachpoint:

1. In the **Teachpoints** tab, select the teachpoint you want to rename.
2. Double-click the teachpoint name, and then type a new name.
3. Click **Save teachpoints** to save the changes in the teachpoint file.

Copying teachpoints

You can use a copy of a teachpoint to create a new teachpoint.

To create a copy of a teachpoint:

1. In the **Teachpoints** tab, click **New Teachpoint.** A new teachpoint entry appears at the bottom of the in the table.
2. Select the teachpoint you want to copy.
3. With the teachpoint selected, Ctrl+drag the teachpoint to the new teachpoint entry.
4. Modify the copy to create a new teachpoint.
5. Click **Save teachpoints** to save the changes in the teachpoint file.

Deleting teachpoints

To delete a teachpoint:

1. In the **Teachpoints** tab, select one or more teachpoints you want to delete in the teachpoints table.
2. Click **Delete selections.**
3. Click **Save teachpoints** to save the changes in the teachpoint file.

Related information

For information about...	See...
Robot Diagnostics	“Software description” on page 24
Using other commands and parameters in the DDR Diagnostics	“DDR Diagnostics” on page 206
Quick reference of DDR Diagnostics commands and parameters	“Quick reference” on page 355

Cycling teachpoints

About teachpoint cycling

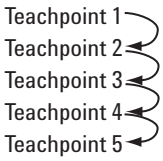
After you have set and verified each teachpoint, you can have the robot transfer labware to and from multiple teachpoints in a cycling pattern as a final check. You can select the teachpoints you want to verify and specify the sequence in which the transfers will occur. Doing so allows you to check the accuracy of the selected teachpoints without having to write or run a protocol.

Cycling sequences

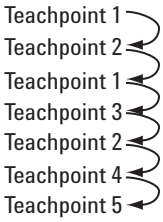
Two types of teachpoint-cycling sequences are available: Sequential, and all permutations.

Sequential

In sequential cycling of teachpoints, the robot will transfer labware to the selected teachpoints in the order you specify. For example, if you select five teachpoints, you can specify the following order:

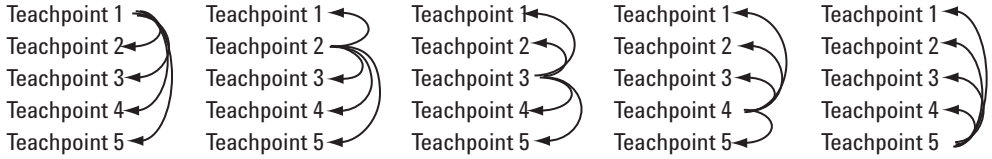


Note: You can select a teachpoint more than once to transfer labware to that location multiple times, as the following example demonstrates.



All permutations

In all-permutations cycling of teachpoints, the robot will transfer robot to the selected teachpoints as shown:



Before you start

Plate stages

IMPORTANT Make sure the device plate stages are extended so that the robot can place labware at these teachpoints during cycling.

The cycling function is a feature of DDR Diagnostics only. During cycling, the VWorks software does not send commands to the devices to open device doors or extend the plate stages. Therefore, you must use the commands in the device diagnostics to move the plate stages into positions before cycling the teachpoints. For instructions on how to move the plate stages into position, see the device user guide.

Labware lids

Be aware that there will be no sensor feedback during cycling. If an error occurs during a delid or relid custom action, the error will not be reported.

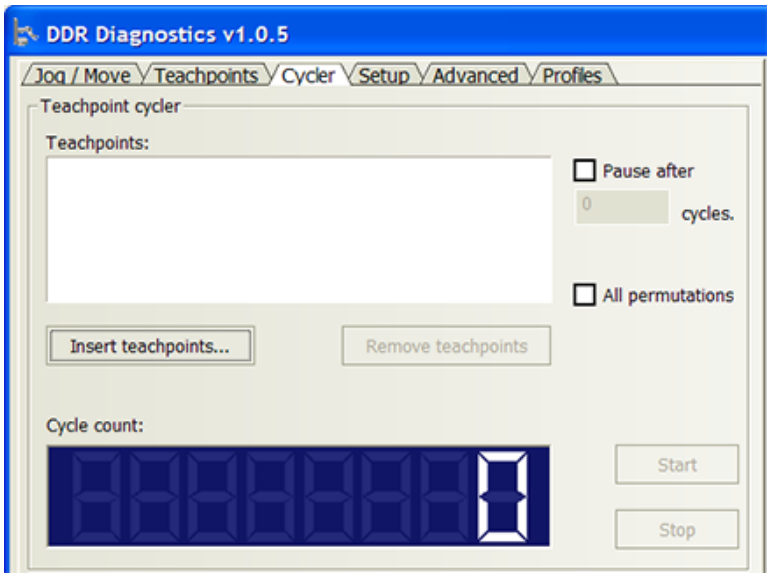
Procedure

WARNING **Be sure to wear protective eyewear when entering the system and working with the robot.**

WARNING **Stay out of the system while the robot is in motion.**

To transfer labware between multiple teachpoints:

1 In **DDR Diagnostics,** click the **Cycler** tab.

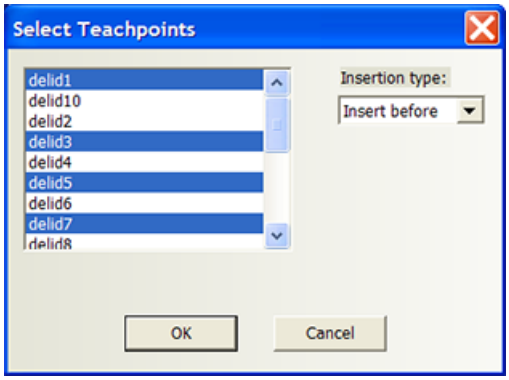


2 Click **Insert teachpoints.** In the **Select Teachpoints** dialog box that opens:

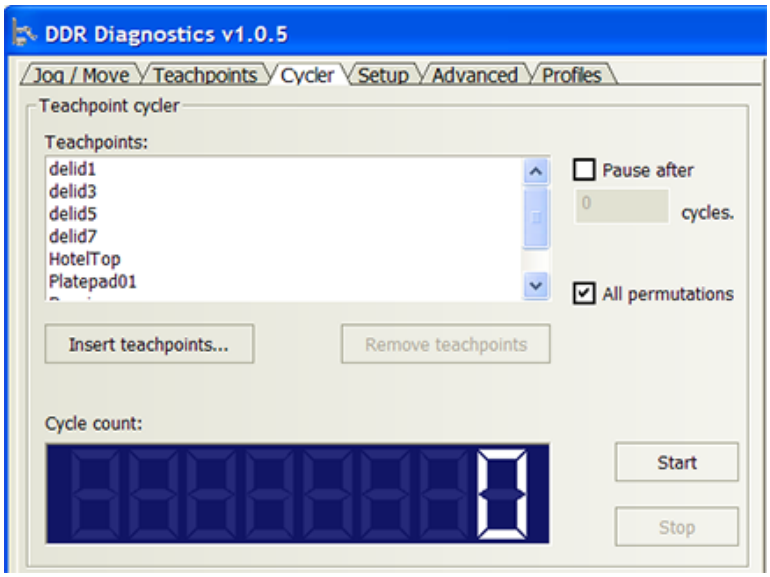
a Select the teachpoints you want to verify. CRTL+click multiple teachpoints to add them simultaneously.

Note: You can select the same teachpoint more than once to indicate that you want to transfer labware to that teachpoint multiple times.

b To arrange the order of the teachpoints, select a teachpoint in the list, and then select either **Insert before** or **Insert after** in the **Insertion types** list.



3 Click **OK** to return to the Cycler tab. The selected teachpoints appear in the Teachpoints list. They should also be in the order you specified.



4 Review the list in the **Teachpoints** area. To remove a teachpoint from the list, select the teachpoint in the list, and then click **Remove teachpoints.**

5 Select **Pause after** if you want to pause the cycling after a specific number of cycles. Type the number of cycles after which you want to pause in the **cycles** box.

6 Select **All permutations** if you want to run that type of cycling sequence. See "Cycling sequences" on page 107.

7 Place the labware at the first teachpoint.

8 When you are ready, click **Start** to begin cycling. Notice that the Start button changes to the Pause button.

During teachpoint cycling, you can:

- Monitor the cycling. To do this, check the number displayed in the **Cycle count** area. You can also view the robot movements in the system or in the **Robot Status** area.
- Pause the cycling. To do this, click **Pause.** The robot will pause after the current pick-and-place action. To resume cycling, click **Resume.**
- Stop the cycling. To do this, click **Stop.** The robot will stop after the current pick-and-place action.

Related information

For information about...	See...
Planning Direct Drive Robot teachpoints	"Planning Direct Drive Robot teachpoints" on page 60
Using other commands and parameters in the Direct Drive Robot Diagnostics	"Using DDR Diagnostics" on page 135
Quick reference of DDR Diagnostics commands and parameters	"Quick reference" on page 217

4 Setting up the 3-Axis Robot

This chapter explains how to set up the 3-Axis Robot for operation. This chapter contains the following topics:

- "Setup Workflow" on page 112
- "Creating and managing 3-Axis Robot profiles" on page 113
- "Setting 3-Axis Robot teachpoints" on page 117
- "Verifying 3-Axis Robot teachpoints" on page 124
- "Editing existing 3-Axis Robot teachpoints" on page 127
- "Renaming 3-Axis Robot teachpoints" on page 128

Note: If the BioCel System has a Direct Drive Robot, see "Setting up the Direct Drive Robot" on page 45. If the BioCel System has a KiNEDx Robot, see "Setting up the KiNEDx Robot" on page 129. If the BioCel System has a Staubli robot, see the *Staubli TX60 Device Driver User Guide*.

Setup Workflow

About this topic

This topic presents the workflow for setting up the 3-Axis Robot for operation.

Workflow

The following table presents the steps for setting up the 3-Axis Robot. After setting up the 3-Axis Robot for the first time, you will not likely change any of the settings in the procedure unless you add a device, replace a device, or move the BioCel System.

IMPORTANT Before proceeding to step 2 (setting teachpoints), you should already have definitions for the labware you want to use. Although you can define labware at any time, Agilent Technologies recommends that you define labware before setting up the BioCel System. For instructions on how to define labware, see the *VWorks Automation Control Setup Guide*.

Step	For this task...	See...
1	Add the 3-Axis Robot to the device file.	"Adding and deleting devices in the software" on page 39
2	Create a profile for the 3-Axis Robot.	"Creating and managing 3-Axis Robot profiles" on page 113
3	Set teachpoints for integrated devices.	"Setting 3-Axis Robot teachpoints" on page 117
4	Verify the teachpoints.	"Verifying 3-Axis Robot teachpoints" on page 124
5	Edit the teachpoints.	• "Editing existing 3-Axis Robot teachpoints" on page 127 • "Renaming 3-Axis Robot teachpoints" on page 128
6	Perform dry run.	"Performing dry runs" on page 153

Related information

For information about...	See...
Operating the BioCel System	"Checking for system readiness" on page 166
Troubleshooting problems	"Maintenance and troubleshooting" on page 173

Creating and managing 3-Axis Robot profiles

About this topic

The BioCel System computer is set up with the correct profiles to communicate with the 3-Axis Robot and integrated devices. You do not need to create new profiles unless you want to set up unique communication settings or use a different teachpoint file. When you integrate a new device in the BioCel System, you will need to create a new profile for that device.

This topic explains how to create a new profile for the 3-Axis Robot and how to manage existing profiles. For instructions on how to create the profiles for Agilent Technologies devices, see the device user documentation. For instructions on how to create profiles for third-party devices, see the device driver user guide.

Profiles

IMPORTANT Each device you integrate in the BioCel System requires a unique profile.

A profile is a collection of settings, stored in the Windows registry, that manages how you connect to a device. A profile:

- Specifies the port used to establish communication between the device and the controlling computer.
- References a teachpoint file. For a description of teachpoint files, see "Setting 3-Axis Robot teachpoints" on page 117.

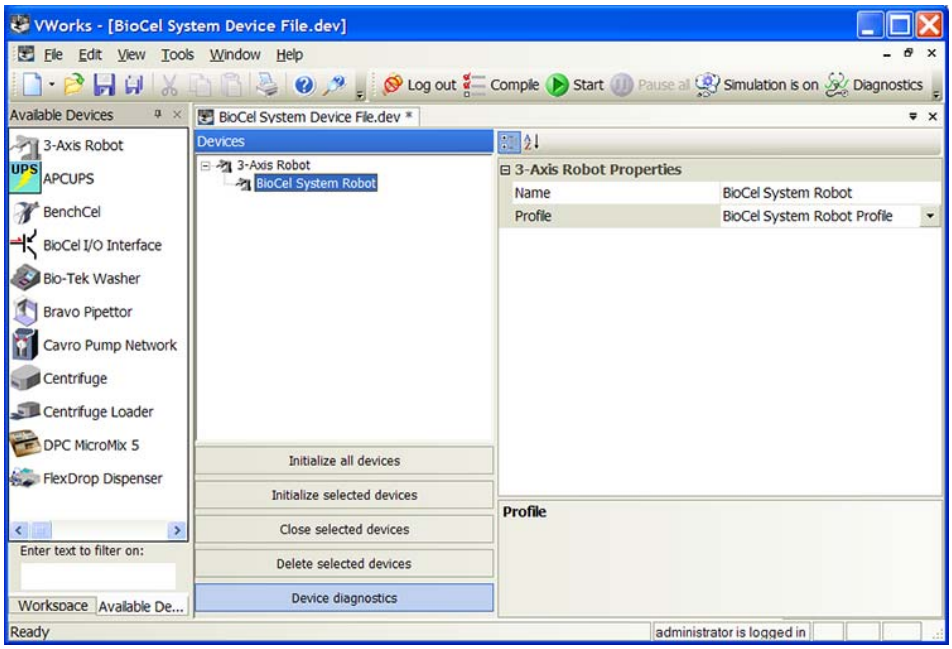
You use the 3-Axis Robot Diagnostics software to create and manage profiles.

Note: The profile is referenced by a device file. For information about device files, see "Adding and deleting devices in the software" on page 39. For a detailed description of the relationships between the device file, profile, and teachpoint file, see the *VWorks Automation Control User Guide*.

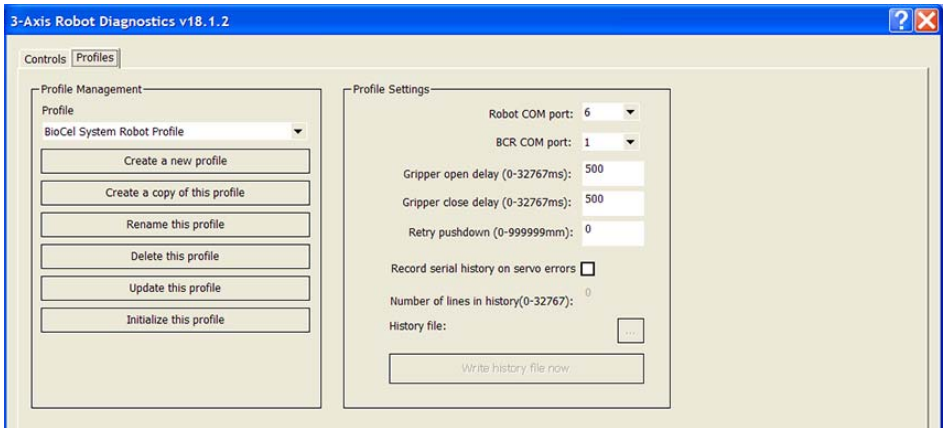
Creating a 3-Axis Robot profile

To create a 3-Axis Robot profile:

1 In the **Devices** area, select the 3-Axis Robot name, and then click **Device diagnostics.**



The 3-Axis Robot Diagnostics dialog box opens.

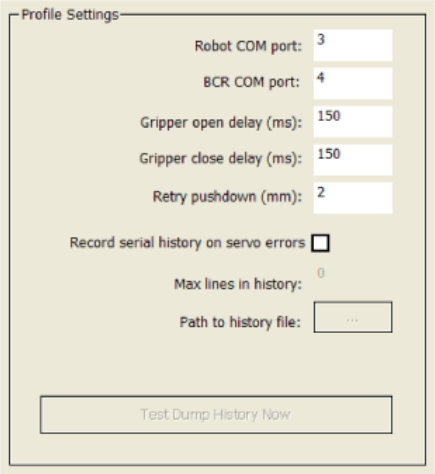


2 Click the **Profiles** tab.

3 In the **Profile Management** area, click **Create a new profile**. The Create Profile dialog box opens.

4 Type a name, and click **OK**. The name appears in the Profile Management area.

5 In the **Profile Settings** area, set or select the following:



Parameter or option	Description
Robot COM port	The serial port that connects the controlling computer to the robot.
BCR COM port	The serial port that connects the robot barcode reader to the controlling computer.
Gripper open delay (ms)	The length of time, in milliseconds, that the robot waits after the grippers start to open. An optimum value allows the robot to fully release the labware before moving to the next destination. A lower-than-optimum value causes the robot to drag the labware from its current location before releasing it at an unintended location.
Gripper close delay (ms)	The length of time, in milliseconds, that the robot waits after the grippers start to close. An optimum value allows the robot to pick up the labware at the correct height before moving to the next destination. A lower-than-optimum value causes the robot to hold the labware higher than the specified height.
Retry pushdown (mm)	The distance, in millimeters, that the robot will push down on a labware after the absence of vacuum is detected at a vacuum filtration station, vacuum platepad, and vacuum shelf. The pressing down on the labware against the station, platepad, or shelf can help ensure a vacuum seal.

Parameter or option	Description
Record serial history on servo errors	The option that enables the software to record the robot communication messages to a log file when a servo error occurs. The log file can be used to troubleshoot the system.
Max lines in history	The maximum number of lines to record in the serial history file. The parameter is available only when the Record serial history on servo errors option is selected.
Path to history file	The folder in which the history file is stored.

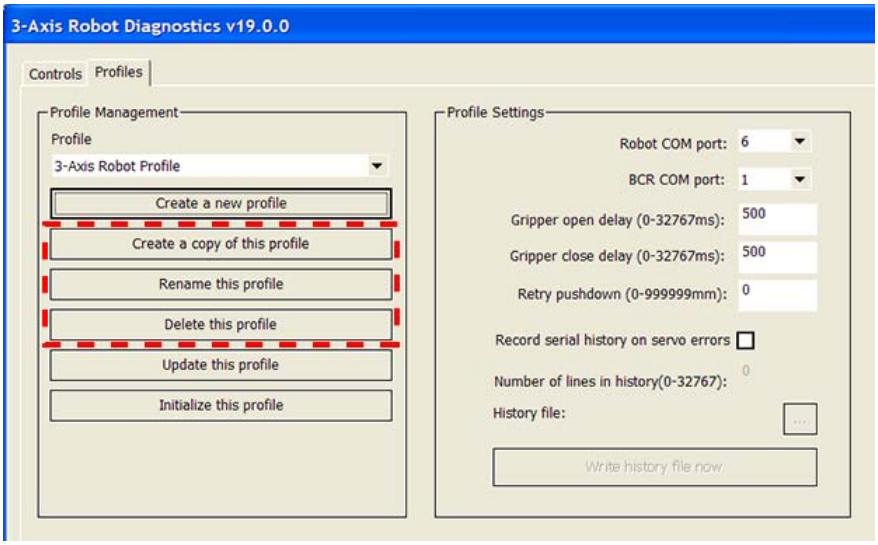
6 Click **Update this profile** to save the changes.

7 Click **OK** to return to the VWorks software window.

8 If you are setting up the BioCel System for the first time or if you are creating a new device file, return to "Adding and deleting devices in the software" on page 39 and continue from step 3.

Managing existing profiles

In the 3-Axis Robot Diagnostics Profile tab, you can select an existing profile, and then copy, rename, or delete the profile.



Related information

For information about...	See...
Adding a device in the VWorks software	"Adding and deleting devices in the software" on page 39
Setting teachpoints	"Setting 3-Axis Robot teachpoints" on page 117

Setting 3-Axis Robot teachpoints

About this topic

The BioCel System is set up with the correct teachpoints to enable the robot to move to the correct locations during a protocol run. You do not need to add or modify the existing teachpoint file unless you:

- Integrate a new device in the BioCel System.
- Move the BioCel System.
- Move or replace one of the devices in the system.
- Adjust settings on the devices.

Depending on the type of device, the teachpoint setting procedure can vary.

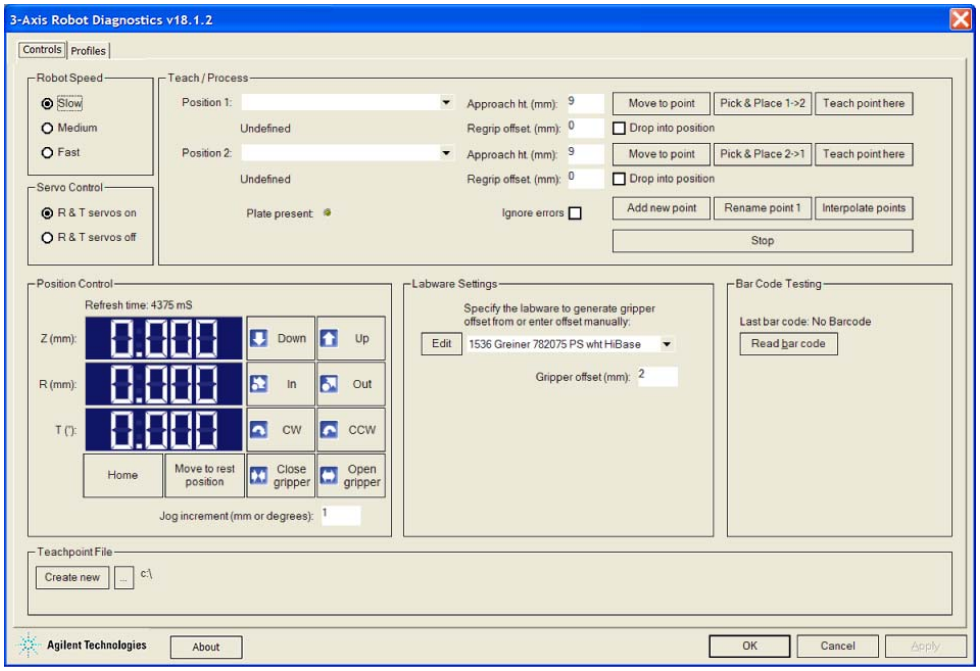
This topic provides basic teachpoint setting concepts: what teachpoints are and how to use teaching jigs to set, verify, and edit 3-Axis Robot teachpoints. Always contact Automation Solutions Technical Support when you want to integrate a new device.

For information about device teachpoints, see the device user guide.

Robot teachpoints

A robot teachpoint is a set of coordinates that define where the robot picks up or places labware. The location can be on an integrated device or a platepad. Teachpoints are relative to the robot home position.

You set, edit, and save teachpoints in 3-Axis Robot Diagnostics.



Teachpoint files

The 3-Axis Robot Teachpoints are saved in a text file. The default teachpoint file is created by Agilent Technologies and is stored in C:\Program Files\Agilent Technologies\VWorks\Teachpoints. However, you can select another location when saving the file.

CAUTION Always edit and manage teachpoints in the Robot Diagnostics software. Do not edit the teachpoint file (text file) directly. In the text file, the teachpoints are in a specific order. Changing the order can cause the robot to move to incorrect locations and bump into devices or other obstacles.

You can have multiple teachpoint files for each BioCel System if a device needs to serve multiple purposes. For example, a platepad can be taught as a platepad or as a regripping station. You can also have multiple teachpoint files for the system if a device is only used in some protocols but not others. For example, if a device is installed on a mobile device table and can be removed when it is not in use.

CAUTION Before you begin changing teachpoints, make a backup copy of the teachpoint file. If the original file becomes lost or damaged, you can use the backup copy instead of resetting all the teachpoints.

The teachpoint file is referenced by a profile. For information about profiles, see "Creating and managing 3-Axis Robot profiles" on page 113.

Workflow

The workflow for setting a 3-Axis Robot teachpoint is as follows:

Step	For this task	See...
1	Set a new teachpoint.	"Setting new teachpoints" on page 119
2	Verify the teachpoint.	"Verifying 3-Axis Robot teachpoints" on page 124
3	Edit the existing teachpoint.	"Editing existing 3-Axis Robot teachpoints" on page 127

Before you start

Make sure:

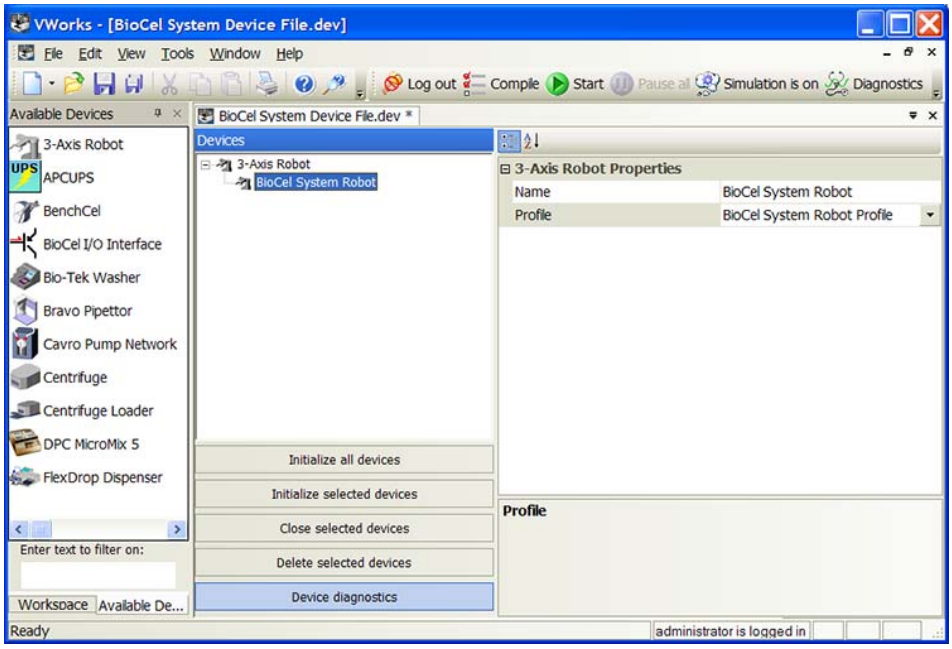
- You have the provided 3-Axis Robot teaching jig.
- The correct profile is initialized ("Creating and managing 3-Axis Robot profiles" on page 113).
- The safety interlock is turned off ("Power panel" on page 7).

Setting new teachpoints

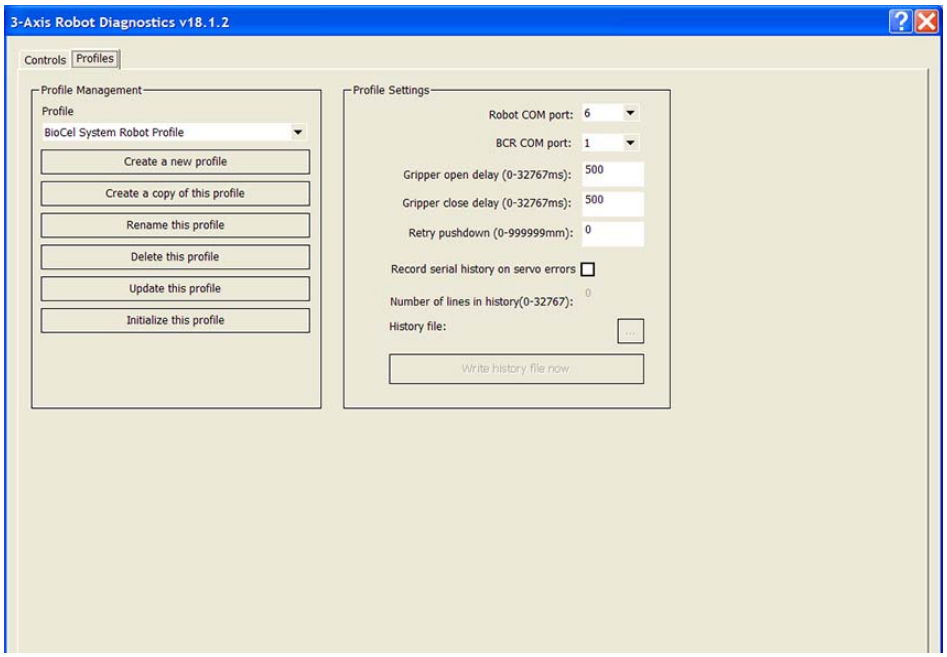
Before you start, place the teaching jig at the location that will be taught (for example, platepad, plate stage, or device shelf). Make sure the teaching jig tab is on the side facing the robot.

To set a teachpoint:

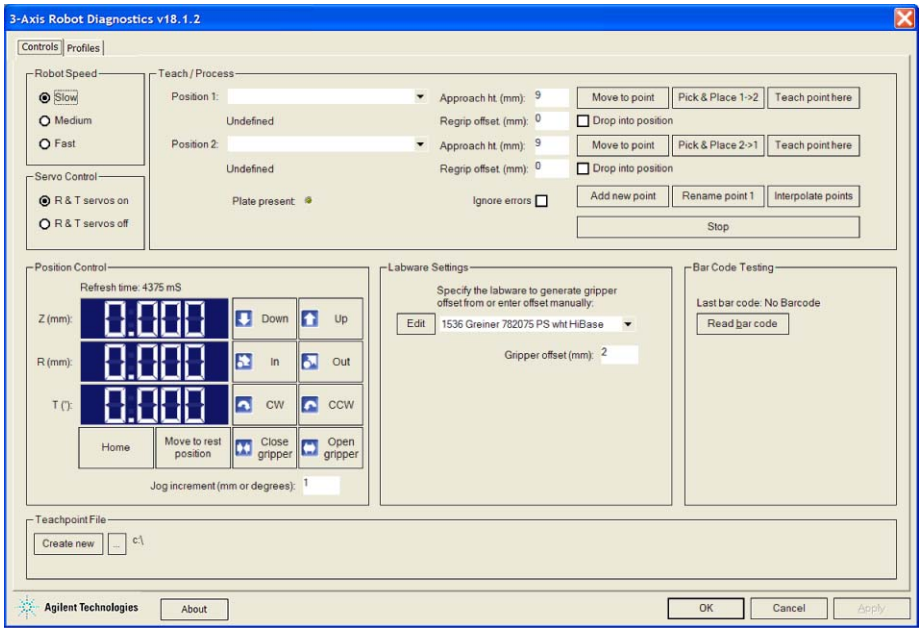
1 In the **Devices** area, select the 3-Axis Robot name, and then click **Device diagnostics.**



The 3-Axis Robot Diagnostics dialog box opens.



2 Click the **Controls** tab.



3 In the **Teach/Process** area, click **Add new point.** The New Teachpoint dialog box opens.

4 Type a name for the new teachpoint, and then click **OK.** The new teachpoint name appears in the Position 1 and Position 2 boxes.

5 Turn off the robot *r*-axis and *t*-axis motors. To do this, in the **Servo Control** area, select **R & T servos off.** The *z*-axis motor remains enabled.

6 Manually move the robot to the teachpoint location. If you need to change the robot height to reach the location, in the **Position Control** area:

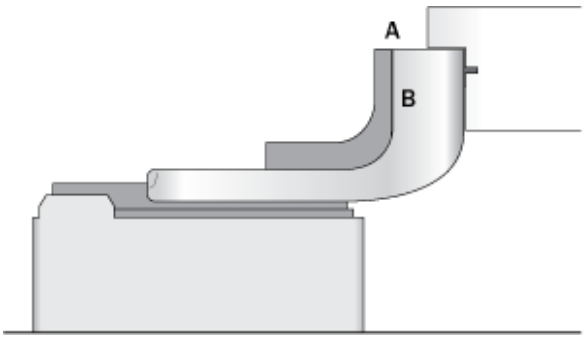
a Type the **Jog Increment** you want to use.

b Click **Down** or **Up** to move the robot down or up.

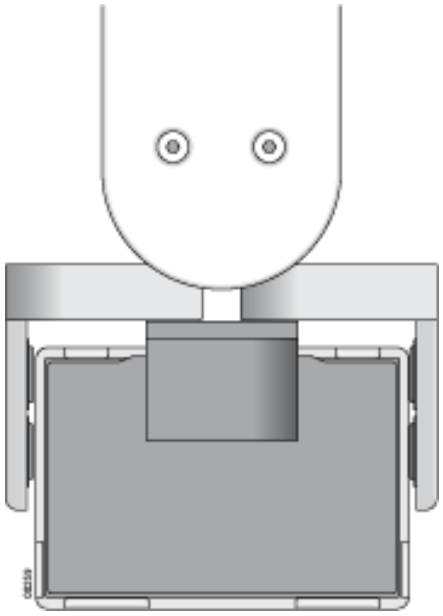
When you move the robot, check its coordinates in the **Position Control** area. If the *t*-axis value is negative, rotate the robot arm 360° so that the *t*-axis value becomes positive.

7 Position the robot and its grippers as follows:

- The top of the teaching jig tab should be level with the top of the robot grippers (A). In addition, the back of the teaching jig tab should be in contact with the front of the robot grippers (B).

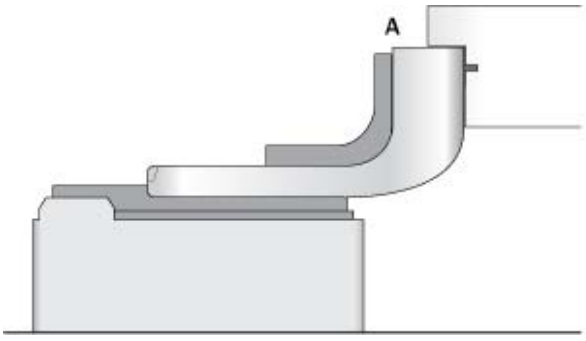


- The teaching jig should be centered between the robot grippers.

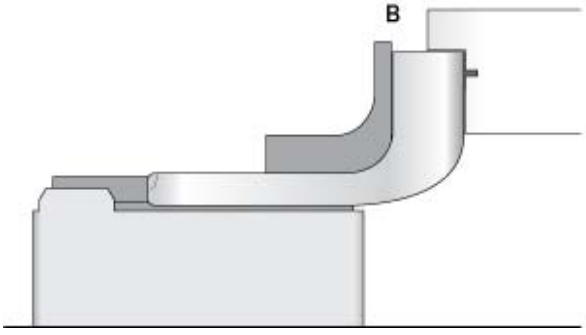


8 If the teachpoint location has high walls or other structures that prevent the robot from holding the teaching jig at the correct height during pickup, type the height difference in the **Regrip offset (mm)** box that corresponds to Position 1.

- If the top of the gripper is higher than the top of the teaching jig tab (A), type a positive value for the height difference.



- If the top of the gripper is lower than the top of the teaching jig tab (B), type a negative value for the height difference.



Note: After you teach the robot this location, install a new platepad in the BioCel System and designate its teachpoint as the regrip station. In a protocol, if the pick location and the place location have different regrip offset values, the system will automatically place the labware at the regrip station between the pick and place tasks to correct the grip height. You need to teach the robot the regrip station platepad. In addition, that platepad can only be used for regripping.

9 In the **Approach ht. (mm)** box that corresponds to Position 1, type the approach height you want to use. The default value is 9 mm.

The approach height is the height clearance (in millimeters) the robot must maintain above the teachpoint as it:

- Moves towards the teachpoint to place labware. Use this parameter if raised tabs or walls at the front of the teachpoint might obstruct the robot.
- Moves away from the teachpoint after picking up labware. Use this parameter if raised tabs or walls at the front of the teachpoint might obstruct the robot.
- Moves to and from the teachpoint when the **Drop into position** option is selected. Use this parameter if raised tabs or walls at the sides of the teachpoint do not obstruct but might be in contact with the robot grippers during labware pickup or placement.

You can reduce the approach height to prevent collision with shelves or other obstacles above the teachpoint.

Agilent Technologies recommends that you set Approach ht at 9 mm. For tipboxes on a Vertical Pipetting Station shelf, set Approach ht at 6 mm. Because the Centrifuge has a short opening, set Approach ht at 5.5 mm. For the Plate Hotel and Plate Hub Carousel, set Approach ht at 7 mm.

CAUTION Incorrect approach heights can cause the robot to crash into obstacles.

10 At **Position 1,** click **Teach point here** to set the teachpoint. In the confirmation dialog box that appears, click **Yes** to confirm the new teachpoint setting.

11 (Optional) Select **Drop into position** if you want the robot to maintain the specified approach height as it picks up and places labware during a protocol run. Use this option if the teachpoint has raised tabs or walls at the sides that might obstruct the robot grippers.

12 Click **Apply** to save the teachpoint information to the teachpoint file.

13 Manually move the robot to the safe zone, and then remove the teaching jig from the new teachpoint.

14 Turn on the robot *r*-axis and *t*-axis motors. To do this, in the **Servo Control** area, select **R & T servos on.**

Related information

For information about...	See...
Robot Diagnostics	“Software description” on page 24
Using other commands and parameters in the 3-Axis Robot Diagnostics	“3-Axis Robot Diagnostics” on page 229
Quick reference of 3-Axis Robot Diagnostics commands and parameters	“Quick reference” on page 355

Verifying 3-Axis Robot teachpoints

After you set a new teachpoint, you should verify that it is accurate. During the verification procedure, you will check that the robot is able to:

- Go to the teachpoint and is positioned correctly at the teachpoint.
- Place labware correctly at the teachpoint.

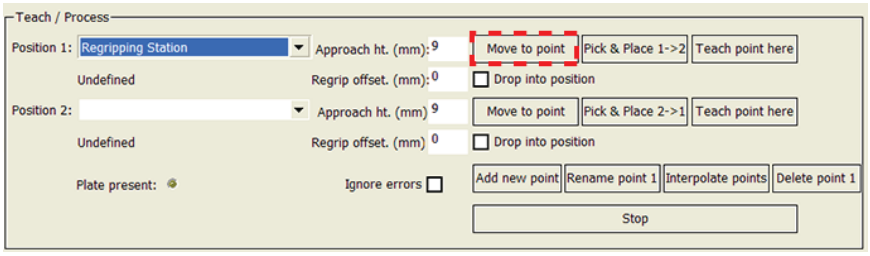
Moving the robot to the new teachpoint

You use the **Move to point** software command to verify that the robot is positioned correctly at the location. Do not use the Move to point command to check the approach height, because the Move to point command does not use the approach height parameter.

IMPORTANT If the teachpoint requires the Drop into position option, skip this verification step and proceed to place the labware at the teachpoint.

To move the robot to the teachpoint:

1. Remove obstacles in the path of the robot.
2. Place the teaching jig at the teachpoint. Make sure the teaching jig tab is on the side facing the robot.
3. Make sure the robot is not holding labware and the grippers are open. To open the grippers, in the **Position Control** area, click **Open Gripper.**
4. In the **Teach/Process** area, select the new teachpoint in the **Location 1** list.
5. In the **Robot speed** area, select **Slow.**
6. In the **Teach/Process** area, clear the check box for **Drop into position.**
7. Click the Position 1 **Move to point** button.



The robot moves to the new teachpoint. The robot remains at the teachpoint and the grippers are open.

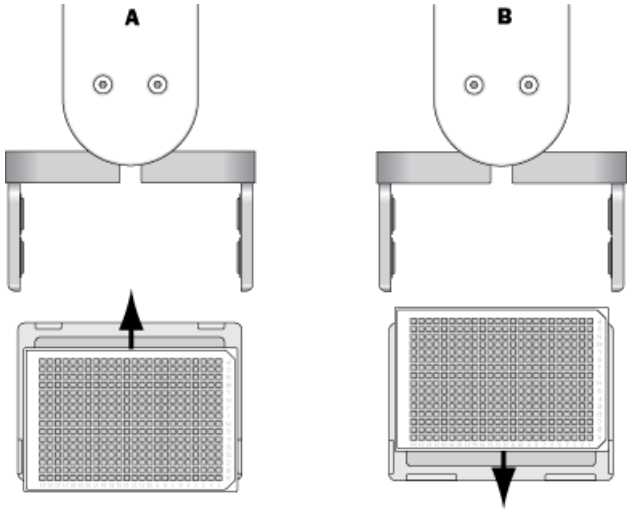
8. Make sure the robot grippers are positioned as instructed in "Setting new teachpoints" on page 119 (step 7 or step 8). If the robot grippers are not positioned correctly, proceed to "Editing existing 3-Axis Robot teachpoints" on page 127.
9. If the robot is positioned correctly at the teachpoint, home the robot. To do this, in the **Position Control** area, click **Move to rest position.**
10. Remove the teaching jig from the teachpoint.

Placing labware at the new teachpoint

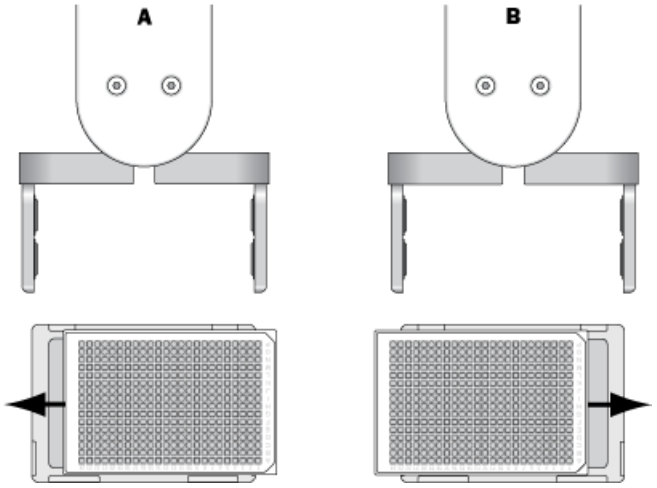
To ensure that the teachpoint is accurate, you need to pick up labware from a reference teachpoint (platepad 1, an existing teachpoint that has been verified to be accurate) and place it at the new teachpoint. Incorrectly placed labware indicates that the teachpoint coordinates are incorrect.

To place labware at a reference teachpoint:

1. Remove obstacles in the path of the robot.
2. Place the desired labware at the reference teachpoint (platepad 1).
3. In the **3-Axis Robot Diagnostics Labware Settings** area, select the labware you are using.
4. In the **Robot Speed** area, select **Slow.**
5. In the **Teach/Process** area:
   a. Select the newly created teachpoint in the **Position 1** list.
   b. Select platepad1 in the **Position 2** list.
6. If the teachpoint does not require Drop into position, in the **Teach/Process** area, clear the check box for **Drop into position.**
7. In the **Teach/Process** area, click **Pick & Place 2 -> 1.** The robot picks up the labware from the reference teachpoint (Location 2) and places it at the new teachpoint (Location 1).
8. Check that the robot does not hit raised walls or other structures as it approaches the teachpoint. If it does, proceed to "Editing existing 3-Axis Robot teachpoints" on page 127.
9. Check the placement of the labware at the teachpoint. If the labware is placed incorrectly, proceed to "Editing existing 3-Axis Robot teachpoints" on page 127. Depending on the placement, make one or more of the following adjustments:
   - If the labware is placed farther out or closer to the robot than it should (as shown in the following diagram), adjust the *r*-axis value in 3-Axis Robot Diagnostics. Decrease the *r*-axis value slightly so that the robot will place the labware closer to the front of its grippers (A). Increase the *r*-axis value so that the robot will place the labware farther from the front of its grippers.



- If the labware is placed too far to the right or left (as shown in the following diagrams), adjust the *t*-axis value in 3-Axis Robot Diagnostics. Decrease the *t*-axis value to move the robot and labware to the left (A). Increase the *t*-axis value to move the robot and labware to the right (B).



- If the labware is dropped onto the teachpoint, decrease the *z*-axis value so that the robot will place the labware onto the teachpoint.
- If the labware is pressed onto the teachpoint, increase the *z*-axis value so that the robot will gently place the labware onto the teachpoint.

10 If the labware is placed correctly, in the **Position Control** area, click **Move to rest position,** and then remove the labware from the teachpoint.

You can repeat the procedure in this section to pick up labware from the new teachpoint and place it at the reference teachpoint. At step 7, in the **Teach/ Process** area, click **Pick & Place 1 -> 2.**

As a final check, repeat the procedure in this section to pick up and place labware at the Fast robot speed. At step 4, select **Fast** in the **Robot Speed** area.

Related information

For information about...	See...
Robot Diagnostics	"Software description" on page 24
Using other commands and parameters in the 3-Axis Robot Diagnostics	"3-Axis Robot Diagnostics" on page 229
Quick reference of 3-Axis Robot Diagnostics commands and parameters	"Quick reference" on page 355

Editing existing 3-Axis Robot teachpoints

When you set a teachpoint for the first time, you will likely set, verify, and edit the teachpoint a number of times to make sure the teachpoint is correct. After the teachpoint is set up correctly, you will not need to adjust or redefine it unless you do the following:

- Move the BioCel System.
- Move or replace one of the devices in the system.
- Adjust settings on the devices.

To edit a robot teachpoint:

1. Make sure you have followed the procedure in "Verifying 3-Axis Robot teachpoints" on page 124 to determine the adjustments that you need to make to the teachpoint. For example, the robot is currently too far to the left of the teachpoint.
2. In the **Diagnostics** tab, verify that the correct teachpoint file is loaded. To do this, in the **Teachpoint file** area, check the file path.
3. In the **Teach/Process** area, make sure the teachpoint you want to edit is selected in the **Position 1** list.
4. With either the teaching jig or labware at the teachpoint, edit the teachpoint using one or both of the following methods:
   - In the **Position Control** area, use the jog command buttons to move the robot to the correct location, and set the teachpoint.
   - Follow the instructions in "Setting new teachpoints" on page 119 to manually move the robot to the correct location, and set the teachpoint.
5. Click **Apply** to save the revised teachpoint in the teachpoint file.

Related information

For information about...	See...
Robot Diagnostics	"Software description" on page 24
Using other commands and parameters in the 3-Axis Robot Diagnostics	"3-Axis Robot Diagnostics" on page 229
Quick reference of 3-Axis Robot Diagnostics commands and parameters	"Quick reference" on page 355

Renaming 3-Axis Robot teachpoints

To rename a teachpoint:

1. In the Robot Diagnostics **Teach/Process** area, select the teachpoint you want to rename in the **Location 1** list.
2. Click **Rename point 1.** The Rename teachpoint dialog box opens.
3. Type a new name for the teachpoint, and then click **OK** to return to the Diagnostics tab.
4. Click **Apply** to save the new teachpoint name in the teachpoint file.

Related information

For information about...	See...
Robot Diagnostics	"Software description" on page 24
Using other commands and parameters in the 3-Axis Robot Diagnostics	"3-Axis Robot Diagnostics" on page 229
Quick reference of 3-Axis Robot Diagnostics commands and parameters	"Quick reference" on page 355

5
Setting up the KiNEDx Robot

This chapter explains how to set up the KiNEDx Robot for operation. This chapter contains the following topics:

- "Setup Workflow" on page 130
- "Creating and managing KiNEDx Robot profiles" on page 131
- "Setting KiNEDx Robot teachpoints" on page 135
- "Verifying KiNEDx Robot teachpoints and waypoints" on page 143
- "Editing KiNEDx Robot teachpoints and waypoints" on page 149

Note: If the BioCel System has a Direct Drive Robot, see "Setting up the Direct Drive Robot" on page 45. If the BioCel System has a 3-Axis Robot, see "Setting up the 3-Axis Robot" on page 111. If the BioCel System has a Staubli robot, see the *Staubli TX60 Device Driver User Guide*.

Setup Workflow

About this topic

This topic presents the workflow for setting up the KiNEDx Robot for operation.

Workflow

The following table presents the steps for setting up the KiNEDx Robot. After setting up the KiNEDx Robot for the first time, you will not likely change any of the settings in the procedure unless you add a device, replace a device, or move the BioCel System.

IMPORTANT Before proceeding to step 2 (setting teachpoints), you should already have definitions for the labware you want to use. Although you can define labware at any time, Agilent Technologies recommends that you define labware before setting up the BioCel System. For instructions on how to define labware, see the *VWorks Automation Control Setup Guide*.

Step	For this task...	See...
1	Add the KiNEDx Robot to the device file.	"Adding and deleting devices in the software" on page 39
2	Create a profile for the KiNEDx Robot.	"Creating and managing KiNEDx Robot profiles" on page 131
3	Set and edit teachpoints for integrated devices.	"Setting KiNEDx Robot teachpoints" on page 135
4	Verify the teachpoints.	"Verifying KiNEDx Robot teachpoints and waypoints" on page 143
5	Edit the teachpoints.	"Editing KiNEDx Robot teachpoints and waypoints" on page 149
6	Perform dry run.	"Performing dry runs" on page 153

Related information

For information about...	See...
Operating the BioCel System	"Checking for system readiness" on page 166
Troubleshooting problems	"Maintenance and troubleshooting" on page 173

Creating and managing KiNEDx Robot profiles

About this topic

The BioCel System computer is set up with the correct profiles to communicate with the KiNEDx Robot and integrated devices. You do not need to create new profiles unless you want to set up unique communication settings or use a different teachpoint file. When you integrate a new device in the BioCel System, you will need to create a new profile for that device.

This topic explains how to create a new profile for the KiNEDx Robot and how to manage existing profiles. For instructions on how to create the profiles for Agilent Technologies devices, see the device user documentation. For instructions on how to create profiles for third-party devices, see the device driver user guide.

Profiles

IMPORTANT Each device you integrate in the BioCel System requires a unique profile.

A profile is a collection of settings, stored in the Windows registry, that manages how you connect to a device. A profile:

- Specifies the port used to establish communication between the device and the controlling computer.
- References a teachpoint file. For a description of teachpoint files, see "Setting KiNEDx Robot teachpoints" on page 135.

You use the Robot Diagnostics software to create and manage profiles.

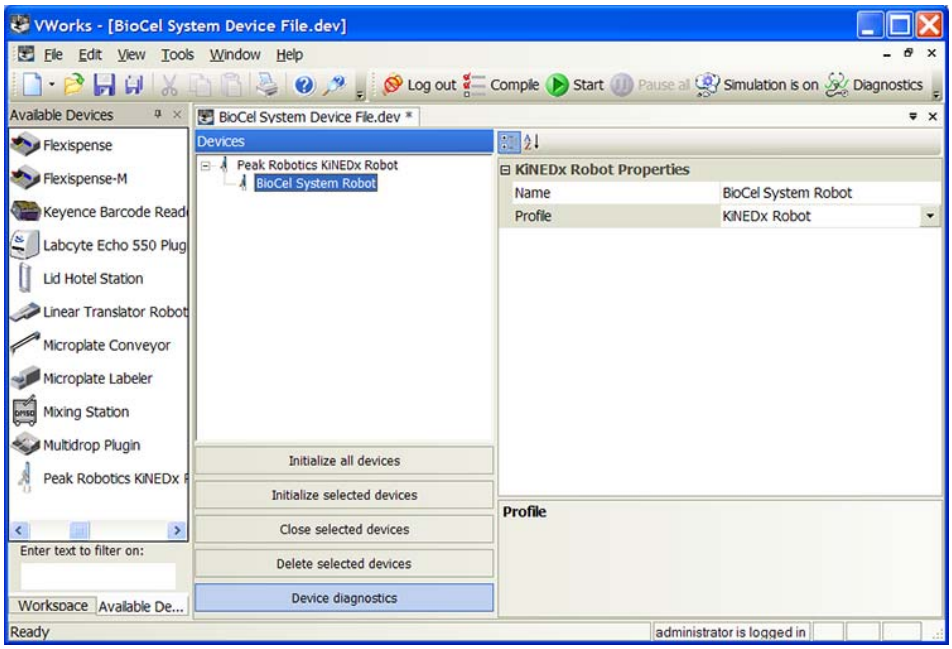
Note: The profile is referenced by a device file. For information about device files, see "Adding and deleting devices in the software" on page 39. For a detailed description of the relationships between the device file, profile, and teachpoint file, see the *VWorks Automation Control User Guide*.

Creating a KiNEDx Robot profile

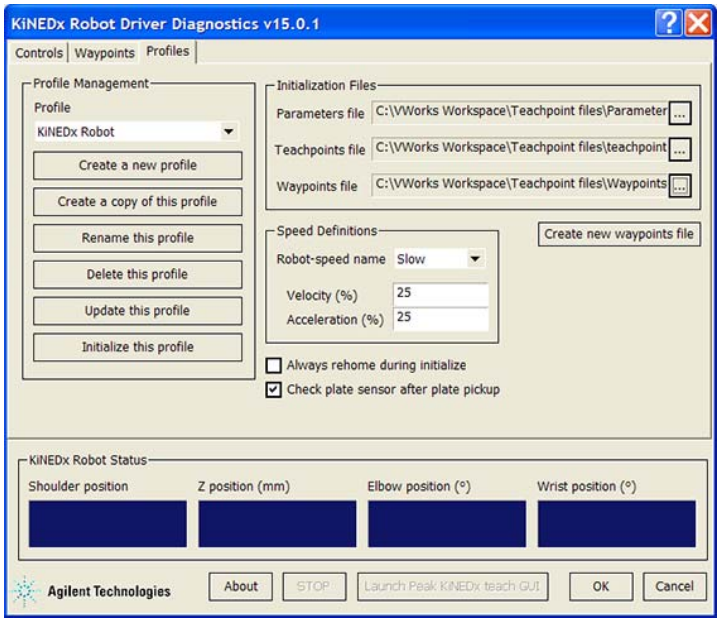
This section explains how to create a profile if the BioCel System uses the KiNEDx Robot.

To create a KiNEDx Robot profile:

1 In the **Devices** area, select the KiNEDx Robot name, and then click **Device diagnostics.**



The KiNEDx Robot Driver Diagnostics dialog box opens.

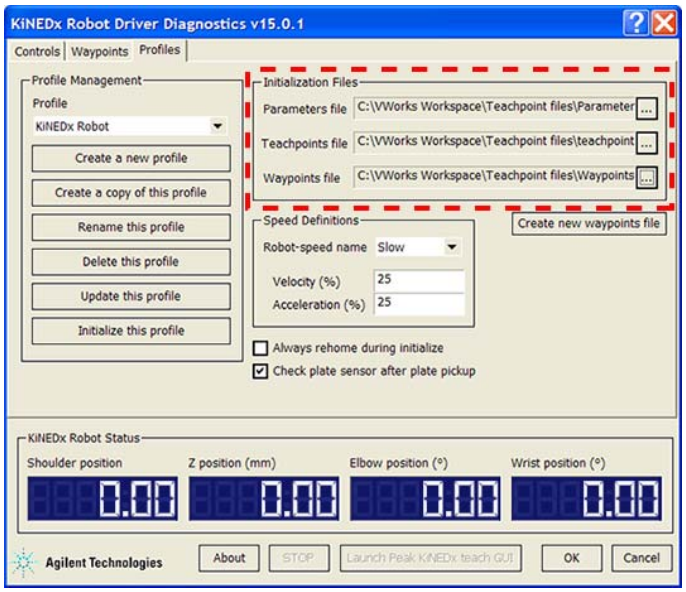


2 Click the **Profiles** tab.

3 In the **Profile Management** area, click **Create a new Profile**. The Create Profile dialog box opens.

4 Type a name and click **OK**. The name appears in the Profile Management area.

5 In the **Initialization Files** area, locate and select the following:



.ini file	Description
Parameters file	The file that contains the robot home coordinates and other data. The file is named Parametersnnnn.ini (where nnnn is the robot serial number). By default, the file is located in the following folder: C:\Program Files\Agilent Technologies\VWorks\Teachpoints\.
Teachpoints file	The file that contains the robot teachpoints. The file is named Teachpointsnnnn.ini (where nnnn is the robot serial number). By default, the file is located in the following folder: C:\Program Files\Agilent Technologies\VWorks\Teachpoints\.

6 Below the **Initialization Files** area, click **Create new waypoints file.**

7 In the dialog box that opens, type the following name for the waypoints file: Waypointsnnnn. The nnnn is the robot serial number. Save the file in the C:\Program Files\Agilent Technologies\VWorks\Teachpoints\ folder. Make sure the file path is displayed in the Initialization Files area.

8 Below the **Speed Definitions** area, select **Check plate sensor after plate pickup.**

9 In the **Profile Management** area, click **Update this profile.**

10 At the front of the KiNEDx Robot, turn on Z-Brake Normal Override (press the switch to the on or **I** position). The red light next to the switch turns off.

Turning on the Z-Brake Normal Override prevents the robot from dropping down along the *z*-axis.

11 Move the robot arm to a safe area so that it will not bump against obstacles as it moves during initialization.

12 In the **Profile Management** area of the KiNEDx Robot Driver Diagnostics dialog box, click **Initialize this profile.** The robot moves briefly as it initializes.

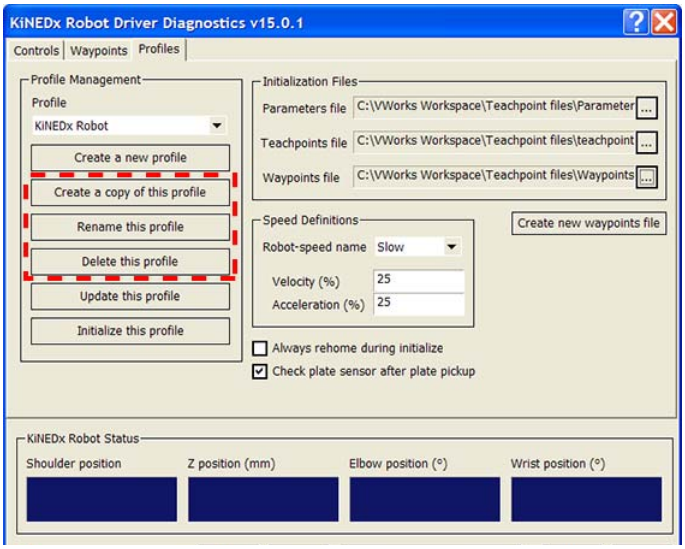
13 Click **Update this profile** to save the changes.

14 Click **OK** to return to the VWorks software window.

15 If you are setting up the BioCel System for the first time or if you are creating a new device file, return to "Adding and deleting devices in the software" on page 39 and continue from step 3.

Managing existing profiles

In the KiNEDx Robot Driver Diagnostics Profile tab, you can select an existing profile, and then rename, copy, or delete the profile.



Related information

For information about...	See...
Adding a device in the VWorks software	"Adding and deleting devices in the software" on page 39
Setting teachpoints	"Setting KiNEDx Robot teachpoints" on page 135

Setting KiNEDx Robot teachpoints

About this topic

The BioCel System is set up with the correct teachpoints to enable the robot to move to the correct locations during a protocol run. You do not need to add or modify an existing teachpoint file unless you:

- Integrate a new device in the BioCel System.
- Move the BioCel System.
- Move or replace one of the devices in the system.
- Adjust settings on the devices.

Depending on the type of device, the teachpoint setting procedure can vary.

This topic provides basic teachpoint setting concepts: what teachpoints and waypoints are, and how to use teaching jigs to set, verify, and edit KiNEDx Robot teachpoints. Always contact Automation Solutions Technical Support when you want to integrate a new device.

For information about device teachpoints, see the device user guide.

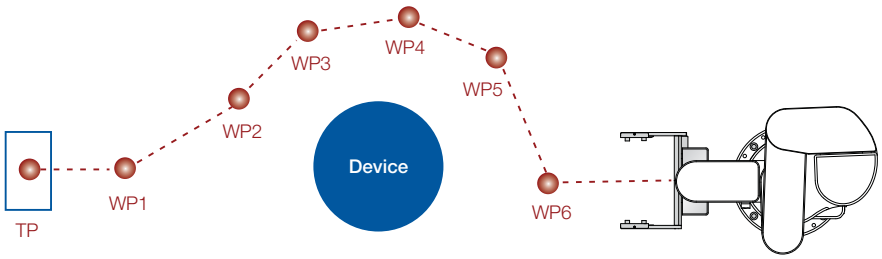
Robot teachpoints and waypoints

A robot teachpoint is a set of coordinates that define where the robot picks up or places labware. The location can be on an integrated device or a platepad. Teachpoints are relative to the robot home position.

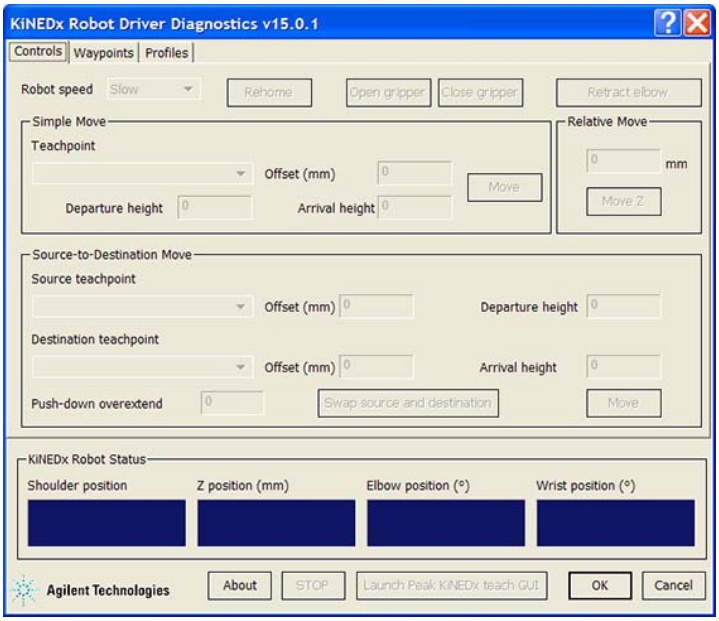
For each teachpoint, the KiNEDx Robot uses at least one waypoint to arrive at the teachpoint. A waypoint is a set of coordinates that define a location the robot passes through on its way to a teachpoint. Having multiple waypoints per teachpoint enable the robot to:

- Move around obstacles that are in a direct path to a teachpoint.
- Maneuver around obstacles in tight spaces.

The following diagram shows examples of waypoints (WP) and teachpoints (TP).



You set, edit, and save teachpoints and waypoints in KiNEDx Robot Driver Diagnostics.



Teachpoint and waypoint files

The KiNEDx Robot Teachpoints are saved in a text file with the .ini file name extension. The default teachpoint file is created by Agilent Technologies and is stored in C:\Program Files\Agilent Technologies\VWorks\Teachpoints\. However, you can select another location when saving the file.

The waypoints are saved in the XML format with the .wpt file name extension. You create a new waypoint file when you create a new profile. For instructions, see "Creating and managing KiNEDx Robot profiles" on page 131.

CAUTION Always edit and manage teachpoints in the KiNEDx Robot Driver Diagnostics software. Do not edit the teachpoint file (text file) or the waypoint file (XML file) directly. In the text file, the teachpoints are in a specific order. Changing the order can cause the robot to move to incorrect locations and bump into devices or other obstacles.

You can have multiple teachpoint files for the BioCel System if a device is only used in some protocols but not others. For example, if a device is installed on a mobile device table and can be removed when it is not in use.

CAUTION Before you begin changing teachpoints and waypoints, make backup copies of the teachpoint and waypoint files. If the original files become lost or damaged, you can use the backup copies instead of resetting all the teachpoints and waypoints.

The teachpoint and waypoint files are referenced by a profile. For information about profiles, see "Creating and managing KiNEDx Robot profiles" on page 131.

Workflow

The workflow for setting KiNEDx Robot teachpoints and waypoints is as follows:

Step	For this task	See...
1	Set a new teachpoint and associated waypoints.	"Setting new teachpoints and waypoints" on page 137
2	Verify the teachpoints.	"Verifying KiNEDx Robot teachpoints and waypoints" on page 143
3	Edit existing teachpoints.	"Editing KiNEDx Robot teachpoints and waypoints" on page 149

Before you start

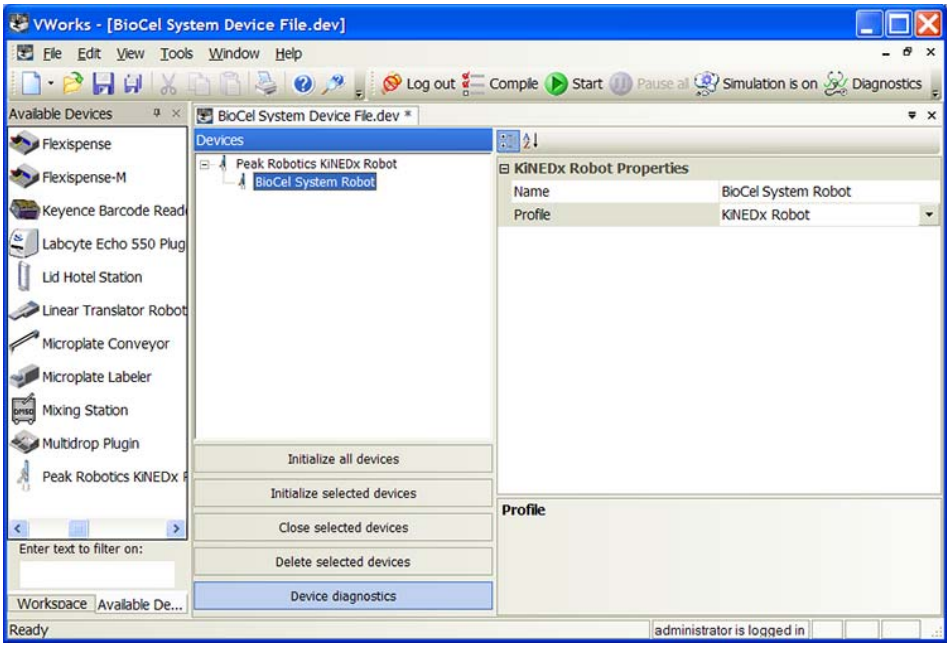
Make sure:

- You have the provided KiNEDx Robot teaching jig.
- The correct profile is initialized ("Creating and managing KiNEDx Robot profiles" on page 131).
- The safety interlock is turned off ("Power panel" on page 7).

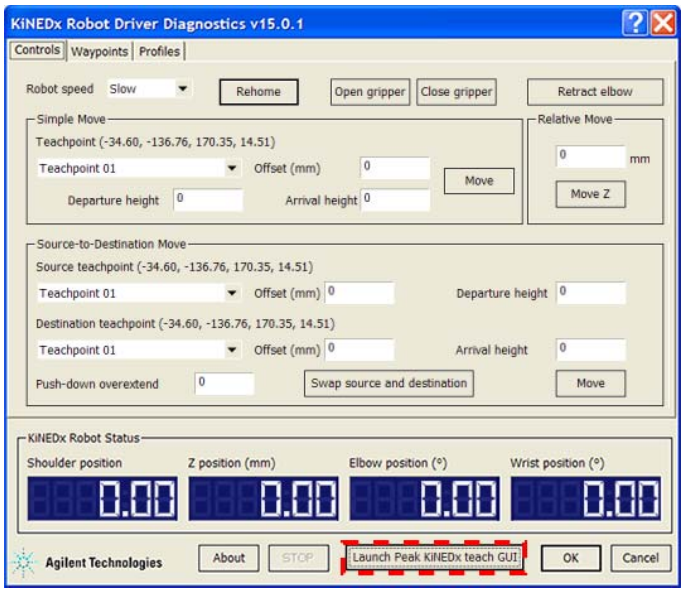
Setting new teachpoints and waypoints

To set a teachpoint:

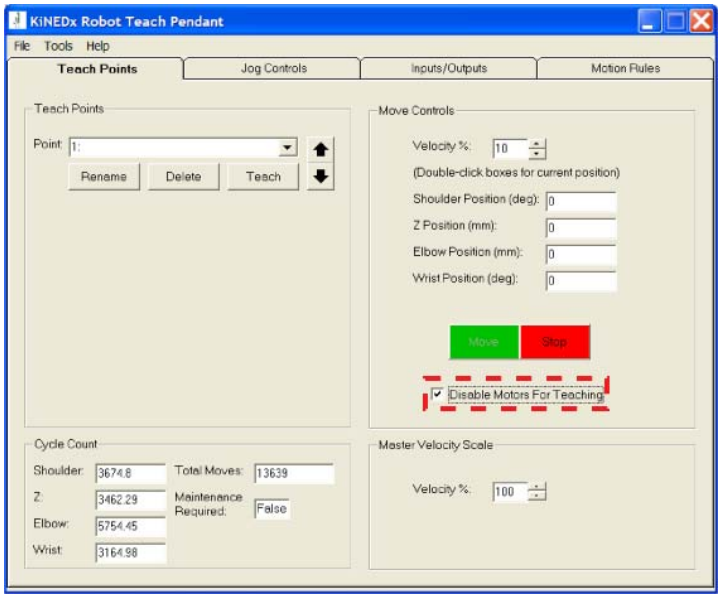
1. Place the teaching jig on the platepad, plate stage, or device shelf you want to teach the robot. Make sure the teaching jig shelves face the robot.
2. In the **VWorks** window, select the KiNEDx Robot name in the **Devices** area, and then click **Device diagnostics.**



The KiNEDx Robot Driver Diagnostics dialog box opens.



3 Click **Launch Peak KiNEDx teach GUI.** The KiNEDx Robot Teach Pendant window appears and displays the Teach Points tab.



4 Turn off the robot wrist, elbow, and shoulder motors. To do this, in the **Move Controls** area, select **Disable Motors for Teaching.**

5 Manually move the robot to the teachpoint or waypoint.

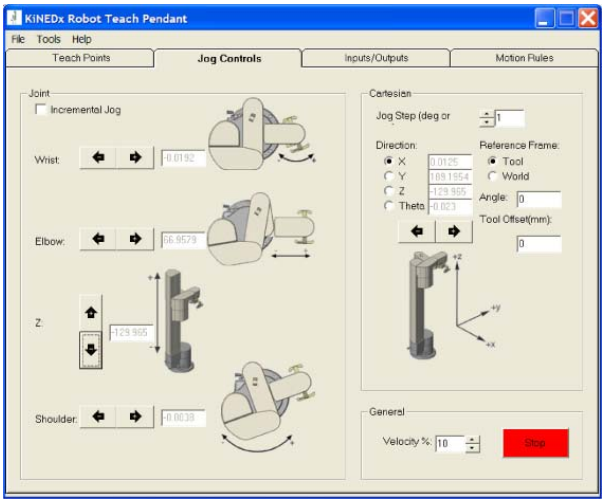
If you need to change the robot height to reach the location, in the **Move Controls** area, clear the **Disable Motors for Teaching** check box to turn on the robot motors. Click the **Jog Controls** tab. In the **Joint** area, click the **Z** up or down button to move the robot up or down.

6 Jog the robot to fine-tune the waypoint or teachpoint. To jog the robot in small increments:

a In the **Teach Points** tab, clear the **Disable Motors for Teaching** check box to turn on the robot motors.

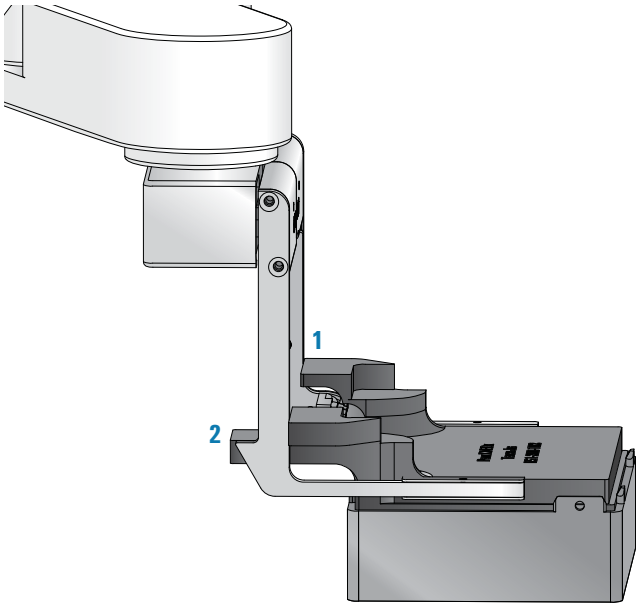
b In the **Jog Controls** tab, use either or both of the following:

- In the **Joint** area, click an arrow to move the robot wrist, elbow, or shoulder. You can also change the robot height. Instead of clicking the arrows, you can type a precise coordinate for the joint movement.
- In the **Cartesian** area, select the axis along which you want the robot to move, and then click an arrow or type a precise coordinate for the movement. In the **Jog Step (deg or mm)** box, set the jog increment in millimeters or degrees.



7 Position the robot and its grippers as follows:

- The teaching-jig shelves should be in contact with the front of the robot grippers (1).
- The top of the teaching-jig wing should be level with the top of the robot gripper wing (2).
- The teaching jig should be centered between the robot grippers.



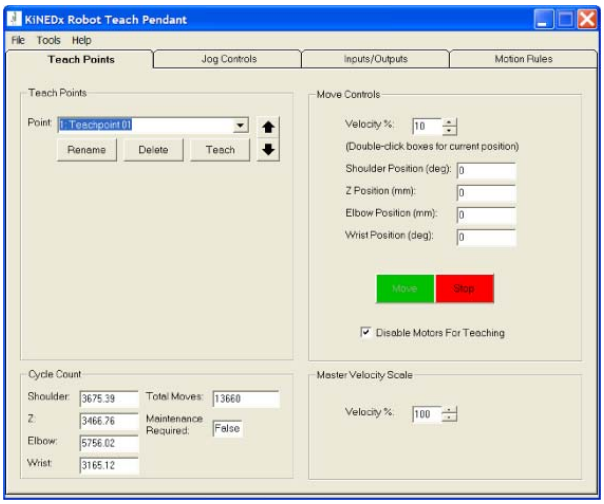
8 Click the **Teach Points** tab. In the **Teach Points** area, name the teachpoint or waypoint you are setting. To do this:

a In the **Point** list, select an unused number, and then click **Rename.** The New Teachpoint dialog box opens.

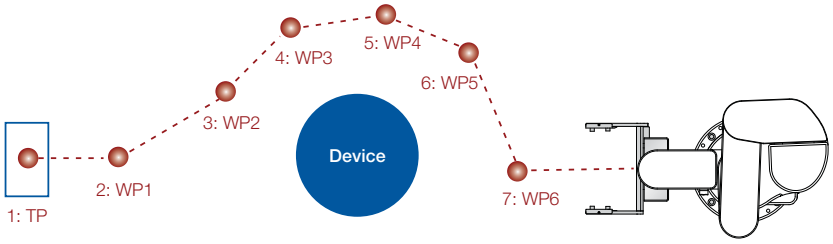
b Type a name for the teachpoint or waypoint, and then click **OK.** The new teachpoint or waypoint name appears in the Point list.

Assign names that will help identify the teachpoint. For example, if the teachpoint is a platepad, type Platepad n, where n indicates the specific platepad on the table. A waypoint for platepad n can be named Platepad n Waypoint m, where m indicates the specific waypoint in the sequence of waypoints.

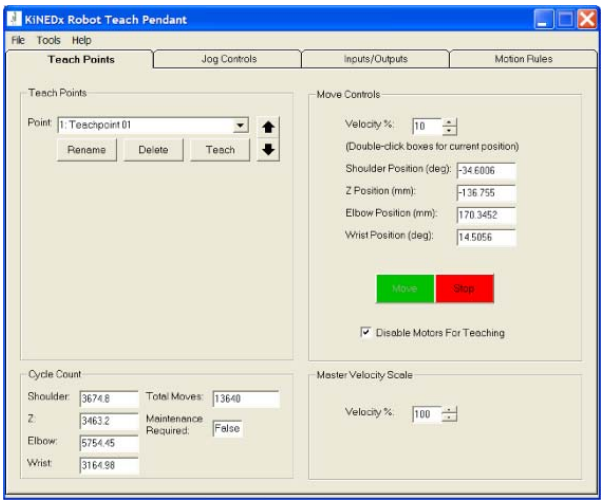
CAUTION Do not reorder the teachpoint or waypoints using the arrow buttons or by editing the teachpoint file. Doing so can result in robot crashes.



The following diagram shows how the teachpoint and waypoints should be numbered in the diagnostics software. Notice that the waypoint number increases as the robot approaches the home position.



9 In the **Move Controls** area, double-click in the **Shoulder Position, Z Position, Elbow Position,** and **Wrist Position** boxes to display the robot's current coordinates.

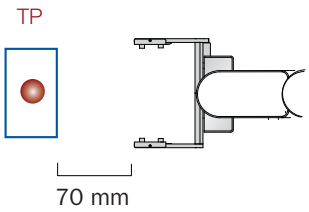


10 In the **Teach Points** area, click **Teach.** In the confirmation dialog box that appears, click **OK.** The new teachpoint or waypoint is saved in the teachpoint file.

11 Manually move and jog the robot to the next point you want to set, and then repeat steps 8 through 10 to set the point.

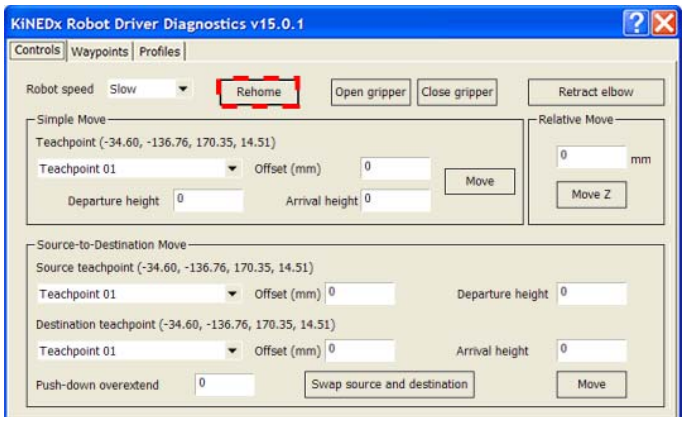
You do not need to create a waypoint at a location directly above the teachpoint. You can specify the height clearance in a later step.

The first waypoint should provide clearance between the teachpoint and the robot grippers. To create the first waypoint, move the robot towards its home position such that the grippers are clear of the edge of the teachpoint.



12 Close the **KiNEDx Robot Teach Pendant** window.

13 Home the robot. To do this, in the **KiNEDx Robot Driver Diagnostics** dialog box, click **Rehome.**



14 Click the **Waypoints** tab. The list of teachpoint and waypoints appear in the table.

15 For each point in the **To reach this point** column:

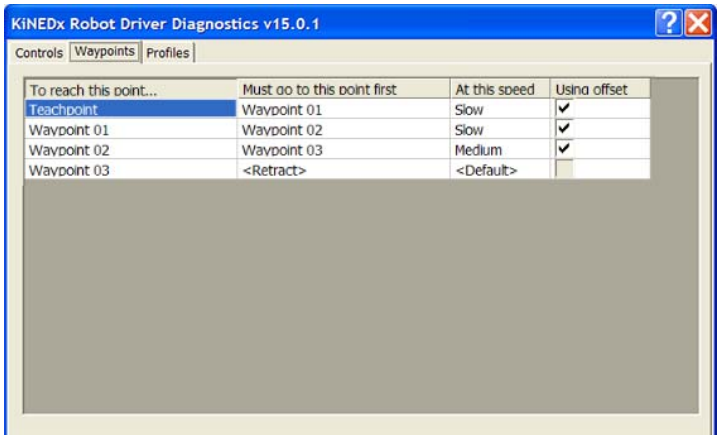
a Select the point that precedes it in the **Must go to this point first column.** For the terminal waypoint (the point closest to the home position), select **Retract** to move the robot into the safe zone.

b Select the speed at which to approach the point in the **At this speed** column.

c Select the check box in the **Using offset** column to have the robot use the device approach height specified in the device file. Doing so allows the robot to approach the teachpoint at the correct clearance height.

Note: The check box is not available for terminal waypoints (points closest to the home position).

The following example shows how to link the teachpoint, the point above the teachpoint, and the waypoints.



Related information

For information about...	See...
KiNEDx Robot Driver Diagnostics description	"Software description" on page 24
Using other commands and parameters in the KiNEDx Robot Driver Diagnostics	"KiNEDx Robot Driver Diagnostics" on page 237
Quick reference of KiNEDx Robot Driver Diagnostics commands and parameters	"Quick reference" on page 355

Verifying KiNEDx Robot teachpoints and waypoints

After you set a teachpoint and corresponding waypoints, you should verify that they are accurate. During the verification procedure, you will check that the robot is able to:

- Move to any point.
- Move between any two points.
- Move labware between two teachpoints.

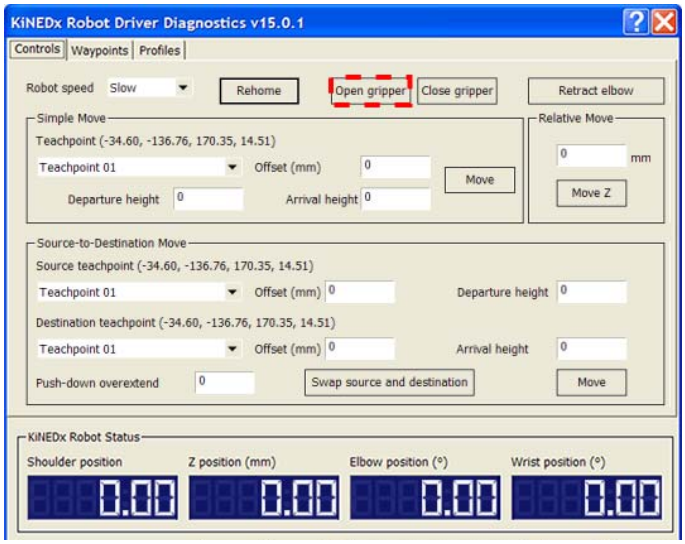
Moving to a waypoint or teachpoint

When you move a robot to a new waypoint or teachpoint, you can check that the robot is moving through the waypoints in the specified order. In addition, you can verify that the robot is positioned correctly at the teachpoint.

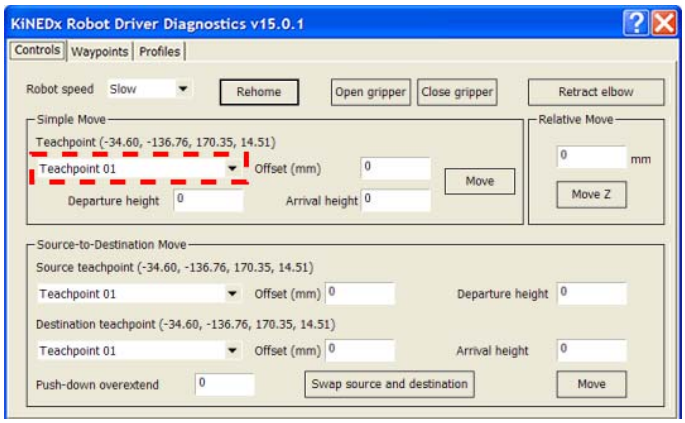
Agilent Technologies recommends that you verify each waypoint, starting from the waypoint closest to the robot home position. Repeat the verification procedure by moving the robot to the adjacent waypoint until you arrive at the teachpoint. Doing so allows you to find and correct any missing or incorrect waypoint links in the Waypoints tab.

To move the robot to a waypoint or teachpoint:

1. Remove obstacles in the path of the robot.
2. Make sure the robot is not holding labware and the grippers are open. To open the grippers, in the **KiNEDx Robot Driver Diagnostics Controls** tab, click **Open gripper.**



3. In the **Robot speed** list, select **Slow.**
4. In the **Simple Move** area, set the parameters:



List or parameter	Description
Teachpoint	The list of teachpoints in the teachpoint file. Select the teachpoint you want to verify.
Departure height	The height clearance, in millimeters, that the robot must maintain above the teachpoint as it moves away from the teachpoint. Set **Departure height** at the value you specified for the device Approach height. You can find the device Approach Height value in the Device Properties area of the VWorks software.
Arrival height	The height clearance, in millimeters, that the robot must maintain above the teachpoint as it moves toward it. Set **Arrival height** at the value you specified for the device Approach height. You can find the device Approach Height value in the Device Properties area of the VWorks software.
Offset	Set **Offset** at 0.

5 In the **Simple Move** area, click **Move.** The robot moves from its current position to the selected waypoint or teachpoint. It pauses briefly at all the waypoints that precede the selected waypoint or teachpoint. The robot remains at the selected waypoint or teachpoint, and the grippers are open.

6 Proceed to "Editing KiNEDx Robot teachpoints and waypoints" on page 149 if:

- The robot skips a waypoint on its way to the selected waypoint or teachpoint. You need to locate and add the missing waypoint link in the waypoints file.
- The robot moves through the waypoints in the incorrect sequence. You need to check the sequence of waypoints and make sure the links are correct.
- The robot arrives at the teachpoint but is not positioned as described in "Setting new teachpoints and waypoints" on page 137 (step 7). You need to correct the robot and gripper position.

7 If the waypoints are not missing, the waypoints are in the correct sequence, and the robot is positioned correctly at the teachpoint:

a Turn off the robot motors. To do this, click **Launch Peak KiNEDx teach GUI.** In the **KiNEDx Robot Teach Pendant** dialog box, click the **Teach Points** tab. In the **Move Controls** area, select **Disable Motors for Teaching.**

b Manually move the robot back to its home position or in the safe zone.

Alternatively, you can home the robot (click **Rehome**) as long as no obstacles or shelves are in the straight-line path of the robot to its home position. When rehoming, the robot moves directly back to the home position without moving through the specified waypoints.

Moving labware between teachpoints

To ensure that the teachpoint is accurate, you need to pick up labware from a reference teachpoint (platepad 1, an existing teachpoint that has been verified to be accurate) and place it at the new teachpoint. Incorrectly placed labware indicates that the teachpoint coordinates are incorrect.

Agilent Technologies recommends that you use this method instead of the Simple Move method when verifying the robot is able to move labware between teachpoints.

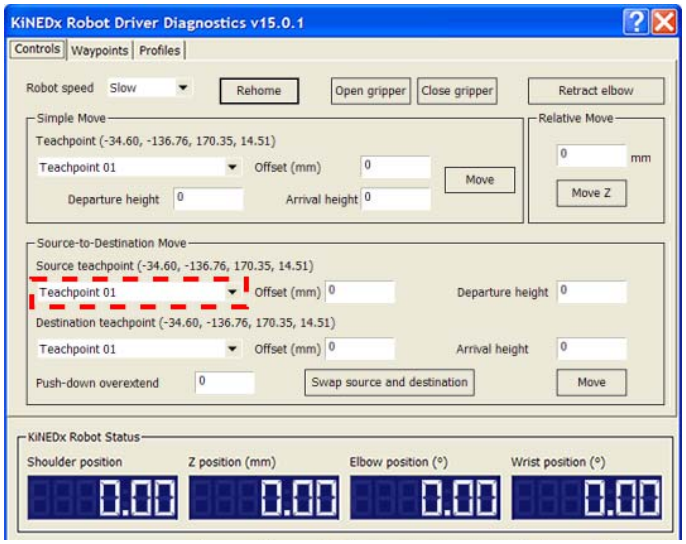
To move labware between teachpoints:

1 Remove obstacles in the path of the robot.

2 Place the desired labware at the reference teachpoint (platepad 1).

3 In the **Robot speed** list, select **Slow.**

4 In the **Source-to-Destination Move** area:



List or parameter	Description
Source teachpoint	The reference teachpoint you want to use. Select **Platepad 1** or a teachpoint that has been verified to be accurate.

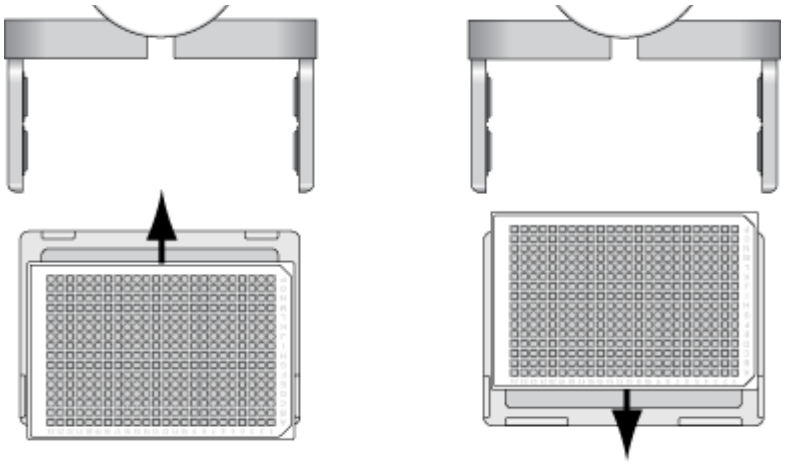
List or parameter	Description
Destination teachpoint	The teachpoint you want to verify. Select from the list.
Offset	Set **Offset** at 0.
Departure height	The height clearance, in millimeters, that the robot must maintain above the reference teachpoint as it moves away from the teachpoint. Set **Departure height** at the value you specified for the device Approach height. You can find the device Approach Height value in the Device Properties area of the VWorks software.
Arrival height	The height clearance, in millimeters, that the robot must maintain above the teachpoint as it moves toward it. Set **Arrival height** at the value you specified for the device Approach height. You can find the device Approach Height value in the Device Properties area of the VWorks software.
Pushdown overextended	The additional *z*-axis distance, in millimeters, that the robot moves down past the teachpoint to secure the placement of the labware. Set **Pushdown overextended** at 0 unless it is a vacuum station that requires the slight pushdown.

5 In the **Source-to-Destination Move** area, click **Move.** The robot picks up the labware from the source (reference teachpoint, platepad 1), moves through all the waypoints, and places the labware at the destination (new teachpoint).

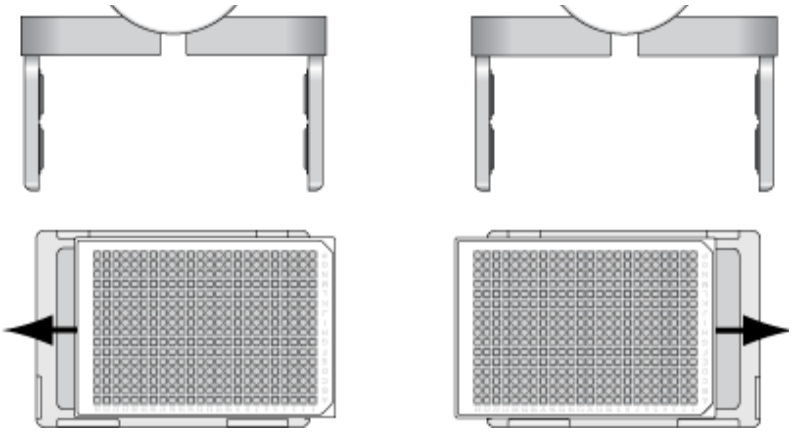
6 Check that the robot does not hit raised walls or other structures as it approaches the teachpoint. If it does, you might need to add an additional waypoint between the point above the teachpoint and the first waypoint. Proceed to "Editing KiNEDx Robot teachpoints and waypoints" on page 149 to add the waypoint.

7 Check the placement of the labware at the teachpoint. If the labware is placed incorrectly, proceed to "Editing KiNEDx Robot teachpoints and waypoints" on page 149. Depending on the placement, make one or more of the following adjustments:

- If the labware is placed farther out or closer to the robot than it should (as shown in the following diagrams), adjust the x- and *y*-axis values slightly so that the robot will place the labware closer to or farther from the front of its grippers.



- If the labware is placed too far to the right or left (as shown in the following diagrams), adjust the *t*-axis value.



- If the labware is dropped onto the teachpoint, decrease the *z*-axis value so that the robot will place the labware onto the teachpoint.
- If the labware is pressed onto the teachpoint, increase the *z*-axis value so that the robot will gently place the labware onto the teachpoint.

8 If the labware is placed correctly, home the robot, and then remove the labware from the teachpoint.

Repeat the procedure in this section to pick up labware from the new teachpoint and place it at the reference teachpoint. At step 5, in the **Source-to-Destination Move** area, click **Swap source and destination** before you click **Move.**

Related information

For information about...	See...
KiNEDx Robot Driver Diagnostics description	"Software description" on page 24
Using other commands and parameters in the KiNEDx Robot Driver Diagnostics	"KiNEDx Robot Driver Diagnostics" on page 237
Quick reference of KiNEDx Robot Driver Diagnostics commands and parameters	"Quick reference" on page 355

Editing KiNEDx Robot teachpoints and waypoints

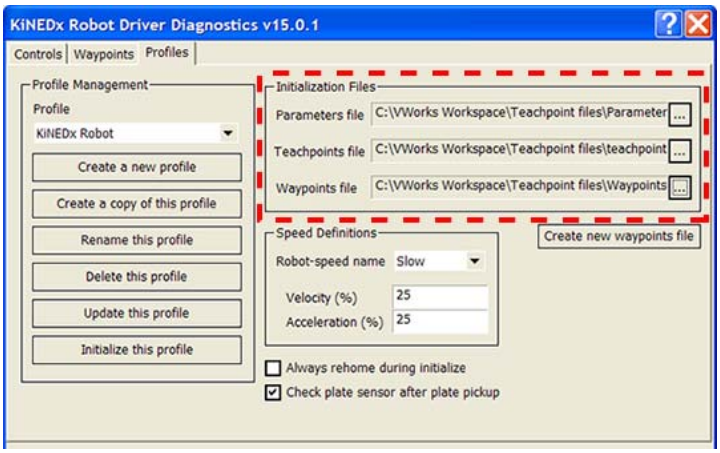
When you set a teachpoint and corresponding waypoints for the first time, you will likely set, verify, and edit the teachpoint and waypoints a number of times to make sure the points are accurate. After the points are set up correctly, you will not need to adjust or redefine them unless you do the following:

- Move the BioCel System.
- Move or replace one of the devices in the system.
- Adjust settings on the devices.

To edit a KiNEDx Robot teachpoint or waypoint:

1 Make sure you have followed the procedure in "Verifying KiNEDx Robot teachpoints and waypoints" on page 143 to determine the adjustments you need to make to the teachpoint or waypoints. For example, the robot is currently too far to the left of the teachpoint.

2 In the **Profiles** tab, verify that the correct teachpoint and waypoint files are loaded. To do this, in the **Initialization files** area, check the file paths.

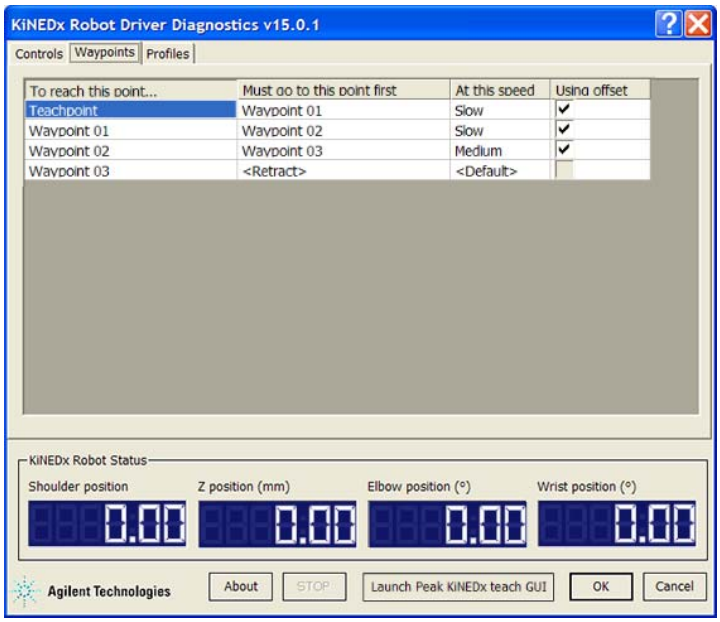


3 If you are searching for missing waypoints or waypoint links:

a Click the **Waypoints** tab.

b Check the table for missing waypoints and waypoint link.

c Follow the instructions in "Setting new teachpoints and waypoints" on page 137 to add new and link waypoints.



4 If you are adjusting an existing teachpoint, with the teaching jig or labware at the teachpoint, edit the teachpoint using one or both of the following methods:

   a Click **Launch Peak KiNEDx teach GUI.** In the **Teach Points** tab, select the teachpoint or waypoint you want to edit. In the **Jog Controls** tab, use the **Joint** or **Cartesian** jog commands and parameters to move the robot to the correct location. In the **Teach Points** tab, set the coordinates and teachpoint.

   b Follow the instructions in "Setting new teachpoints and waypoints" on page 137 to manually move the robot to the correct location, and set the teachpoint.

Related information

For information about...	See...
KiNEDx Robot Driver Diagnostics description	"Software description" on page 24
Using other commands and parameters in the KiNEDx Robot Driver Diagnostics	"KiNEDx Robot Driver Diagnostics" on page 237
Quick reference of KiNEDx Robot Driver Diagnostics commands and parameters	"Quick reference" on page 355

6
Preparing for a protocol run

Before you start a protocol run, you should check the various devices in the BioCel System to ensure optimum operation.

This chapter contains the following topics:

- "Workflow for preparing a protocol run" on page 152
- "Performing dry runs" on page 153
- "Reviewing protocols and planning for the run" on page 154
- "Adding or removing devices mounted on docking tables" on page 155
- "Checking for system readiness" on page 166
- "Replacing the waste bin" on page 167
- "Loading labware in the system" on page 169
- "Stopping a run in an emergency" on page 171

Workflow for preparing a protocol run

Workflow

The workflow for preparing a protocol run is as follows:

Step	For this task...	See...
1	Review the protocol and plan for the run.	"Reviewing protocols and planning for the run" on page 154
2	Add devices that are mounted on docking tables.	"Adding or removing devices mounted on docking tables" on page 155
3	Check the system for readiness.	"Checking for system readiness" on page 166
4	Replace the waste bin.	"Replacing the waste bin" on page 167
5	Load labware in the system.	"Loading labware in the system" on page 169

Related information

For information about...	See...
Setting up the system	"Setting up the BioCel System" on page 27
Setting teachpoints	One of the following: • "Setting Direct Drive Robot teachpoints" on page 69 • "Setting 3-Axis Robot teachpoints" on page 117 • "Setting KiNEDx Robot teachpoints" on page 135
Troubleshooting the system	"Maintenance and troubleshooting" on page 173

Performing dry runs

What is a dry run?

A dry run is when you run a protocol using empty labware. A dry run allows you to troubleshoot a protocol or a component of the system without wasting valuable reagents and samples. You should always perform a dry run to check a new protocol.

Correcting teachpoint errors

After setting the teachpoints, be sure to perform a dry run as a final check for any teachpoint errors. The dry run also allows you to fine-tune orientation settings in systems that have the Direct Drive Robot.

Preparing for a dry run

You prepare for a dry run the same way you would prepare for a real protocol run. For the preparation workflow, see "Workflow for preparing a protocol run" on page 152.

Related information

For information about...	See...
Writing protocols	*VWorks Automation Control User Guide*
Preparing for a run	"Workflow for preparing a protocol run" on page 152
Workflow for setting teachpoints	One of the following: • "Setting Direct Drive Robot teachpoints" on page 69 • "Setting 3-Axis Robot teachpoints" on page 117 • "Setting KiNEDx Robot teachpoints" on page 135 • *Staubli TX60 Device Driver User Guide*

Reviewing protocols and planning for the run

Procedure

Before you start a run, make sure you review the protocol and determine:

- The devices used in the protocol and how to prepare them for operation. For example, you might need to load a roll of seal on the PlateLoc Sealer or install a pipette head on a Vertical Pipettor. See the device user guides for setup instructions.
- The optimal device setup sequence. In general, you first set up devices that do not hold time-sensitive reagents. Leave complex preparations, which might use expensive and unstable reagents, until last.
- The labware used in the protocol and where they should be positioned before the run starts. For example, you might have to load labware into one or more storage devices such as the Labware Stacker and the Plate Hub Carousel.
- The waste bins that should be emptied.
- The reservoirs that must be filled.

Be sure to check the protocol User Message tasks for setup information. If the User Message tasks prompt you to place counterweight labware, you do not have to include these steps in the setup.

Related information

For information about...	See...
Creating or revising protocols	*VWorks Automation Control User Guide*
Adding or removing devices that are on docking tables	"Adding or removing devices mounted on docking tables" on page 155
Checking the system for readiness	"Checking for system readiness" on page 166
Replacing the waste bin	"Replacing the waste bin" on page 167
Troubleshooting the system	"Loading labware in the system" on page 169
Stopping the protocol run in an emergency	"Stopping a run in an emergency" on page 171

Adding or removing devices mounted on docking tables

About this topic

WARNING **Unlocking and removing protective windows, defeating interlocks and reconfiguring the system can expose you to serious hazards and may invalidate the safety compliance certification.**

Only trained BioCel System administrators should perform the procedures in this topic.

For a description of docking tables, see "Docking tables (optional)" on page 9.

Workflow for adding or removing devices mounted on docking tables

Adding devices mounted on docking tables

The workflow for adding devices that are mounted on docking tables is as follows:

Step	For this task...	See...
1	*Multiple docking-table systems only.* Remove the protective window from the side of the system where the table will be docked.	"Removing and installing protective windows" on page 156
2	If applicable, connect the interlock cables to the E-STOP connectors on the system patch panel.	"Connecting to and disconnecting from the interlock system" on page 157
3	Dock the table.	One of the following: • "Docking and undocking the table automatically" on page 158 • "Docking and undocking the table with levers" on page 161 • "Docking and undocking the table with leveling casters" on page 163

Removing devices mounted on docking tables

The workflow for removing devices that are mounted on docking tables is as follows:

Step	For this task...	See...
1	Undock the table.	One of the following: • "Docking and undocking the table automatically" on page 158 • "Docking and undocking the table with levers" on page 161 • "Docking and undocking the table with leveling casters" on page 163
2	If applicable, disconnect the interlock cables from the E-STOP connectors on the system patch panel.	"Connecting to and disconnecting from the interlock system" on page 157
3	*Multiple docking-table systems only.* Install the protective window on the side of the system that is exposed.	"Removing and installing protective windows" on page 156

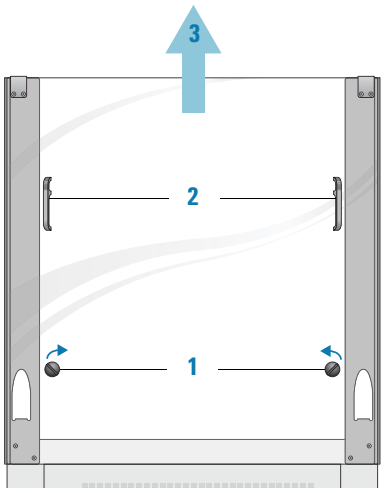
Removing and installing protective windows

In modular systems where multiple docking tables are interconnected, removable windows are installed on sides that permit the addition of docking tables. In these systems, you must first remove the protective window before docking a table, and install the protective window after undocking a table.

Removing the protective window on a docking table

To remove the protective window:

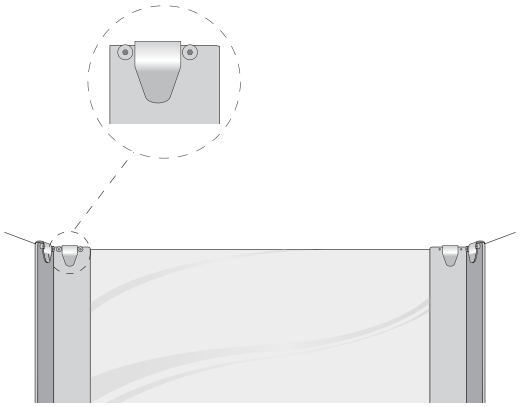
1. *Windows without interlocks only.* Using a 9-mm hex wrench, turn the two locks to unlock the window from the frame (1).
2. *Windows with interlocks only.* Turn the two black knobs on the window to unlatch the window from the frame (1).
3. While holding the handles (2), pull the bottom of the window outwards a few inches, then lift the window up until the window clamps are free from the top of the frame (3).



Installing the protective window

To install the protective window:

1 While holding the handles on the window, slide the window downward onto the front of the frame. Behind one of the frame posts are two screws. Make sure the corresponding window clamp fits between the two screws, as shown.



2 *Windows with interlocks only.* Turn the black knobs on the windows to secure the window latches.

3 *Windows without interlocks only.* Using a 9-mm hex wrench, turn the lock to secure the window latches.

Connecting to and disconnecting from the interlock system

If devices on the docking table or if the protective windows on the docking table use the safety interlock system, you must connect them to the system interlock circuit when docking the table. When undocking the table, you must disconnect the devices or windows from the interlock circuit.

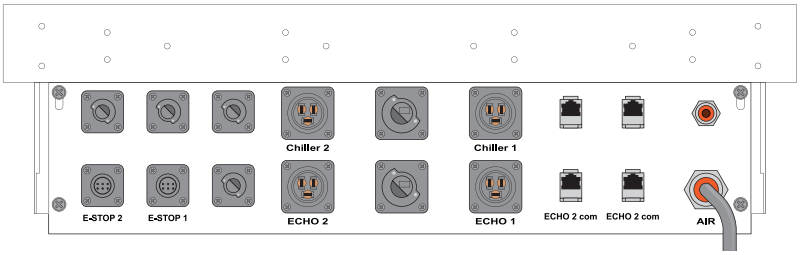
IMPORTANT The safety interlock circuit must be closed for the system to operate. You can use the supplied jumper to close the circuit after disconnecting the devices.

Connecting to the interlock circuit

To connect the devices or windows to the interlock circuit:

1. *Devices only*. Remove the jumpers from the **E-STOP** connectors on the system patch panel (in the lower cabinet of the system).
2. Connect the interlock cables from the devices or windows to the **E-STOP** connectors on the system patch panel (in the lower cabinet of the system). Turn the connector clockwise until the connection is secure.

   Note: The patch panel configuration can vary by system. Use the labels on the panel to identify the correct connectors for the devices and windows.



Disconnecting from the interlock circuit

To disconnect the devices or windows from the interlock circuit:

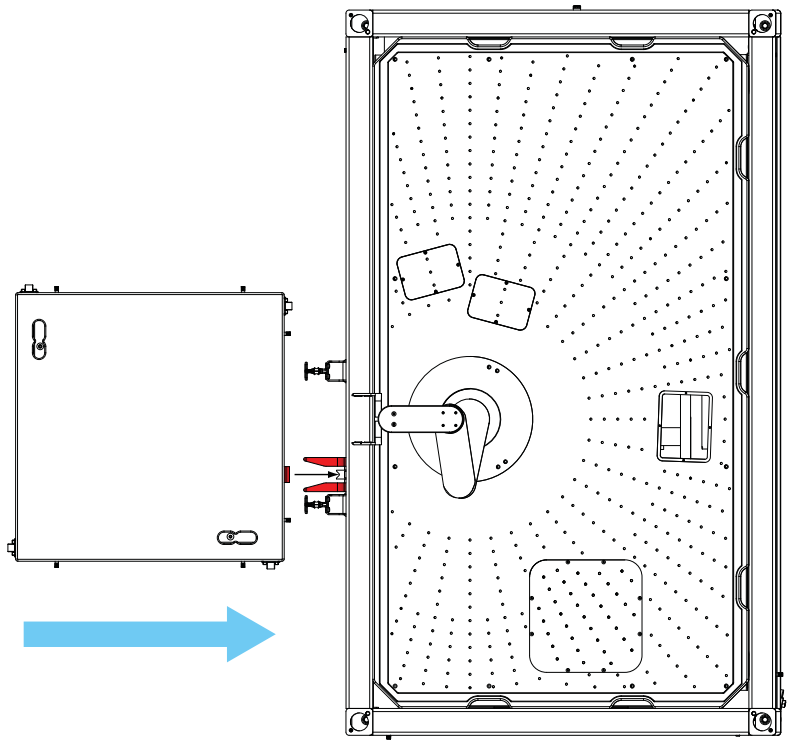
1. Disconnect the device or window interlock cables from the **E-STOP** connectors on the system patch panel. Turn the connectors counterclockwise to loosen and remove the connectors.
2. *Devices only*. Install the supplied jumpers at the device **E-STOP** connectors on the system patch panel.

Docking and undocking the table automatically

If the docking table is equipped with the QuickDock feature, the docking and undocking processes are automated.

To dock the table using the QuickDock feature:

1. Move the docking table so the red alignment tab on the docking table faces the two red alignment tabs on the BioCel System.
2. Push the table against the BioCel System, making sure the red alignment tab on the docking table fits between the two red alignment tabs on the BioCel System.



3 Check the docking pendant. The pendant should display UNDOCKED and READY. If it does not, check the alignment of the table.

4 Press the pendant button. Lights on the pendant flash momentarily.

When the table is docked securely, the pendant displays READY and DOCKED.

5 Follow instructions in one of the following sections to verify the teachpoints of the devices on the docking table:

- "Verifying Direct Drive Robot teachpoints" on page 90
- "Verifying 3-Axis Robot teachpoints" on page 124
- "Verifying KiNEDx Robot teachpoints and waypoints" on page 143

To undock the table using the QuickDock feature:

1 Check the docking pendant. The pendant should display READY and DOCKED.

2 Press the pendant button. Lights on the pendant flash momentarily.

When the table is undocked, the pendant displays UNDOCKED and READY.

3 Move the docking table away from the BioCel System.

Docking and undocking the table with levers

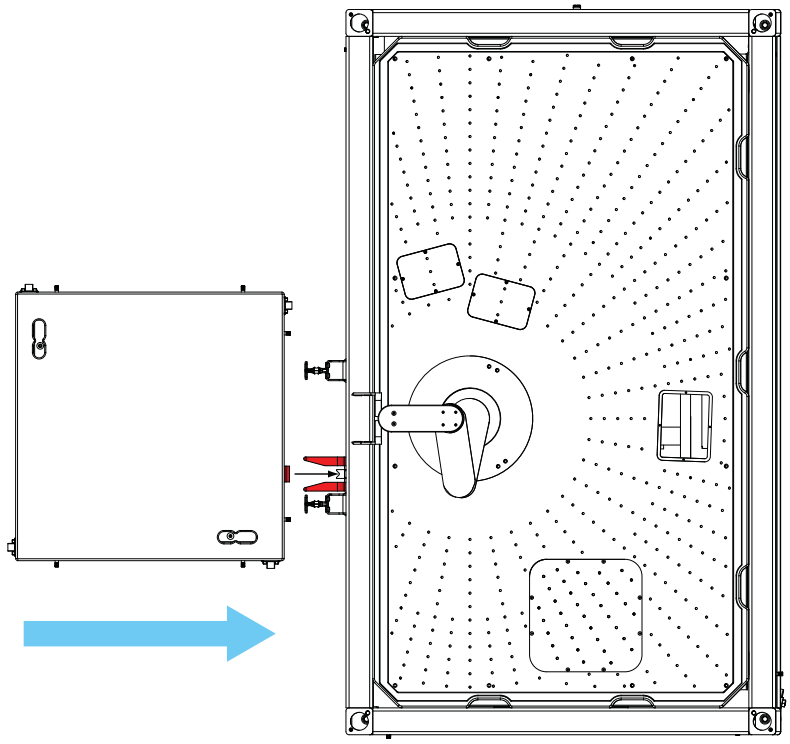
If the docking table is equipped with levers, the docking and undocking processes are performed manually.

Docking the table that has levers

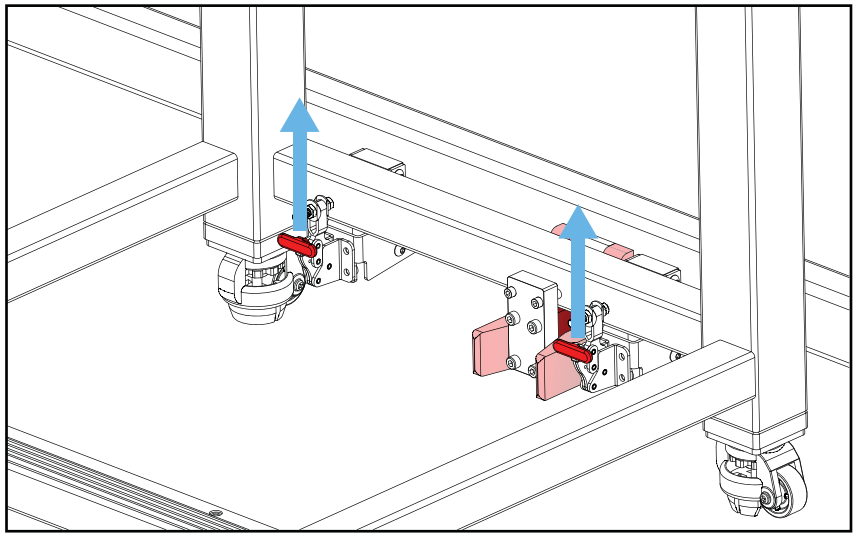
To dock the table that has levers:

1 Move the docking table so the red alignment tab on the docking table faces the two red alignment tabs on the BioCel System.

2 Push the table against the BioCel System, making sure the red alignment tab on the docking table fits between the two red alignment tabs on the BioCel System.



3 Under the docking table, firmly push up the two red levers until you hear them click. The click sound confirms that the table is docked.



4 Check that the table is securely docked. To do this, make sure the table does not move when you try to pull it away from the BioCel System.

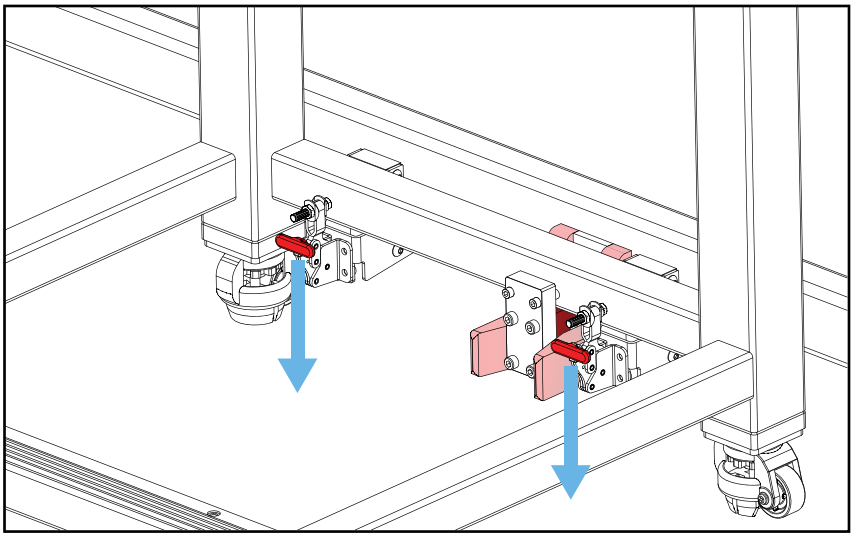
5 Follow instructions in one of the following sections to verify the teachpoints of the devices on the docking table:

- "Verifying Direct Drive Robot teachpoints" on page 90
- "Verifying 3-Axis Robot teachpoints" on page 124
- "Verifying KiNEDx Robot teachpoints and waypoints" on page 143

Undocking the table that has levers

To manually undock the table that has levers:

1 Under the docking table, firmly push down the red levers.



2 Move the docking table away from the BioCel System.

Docking and undocking the table with leveling casters

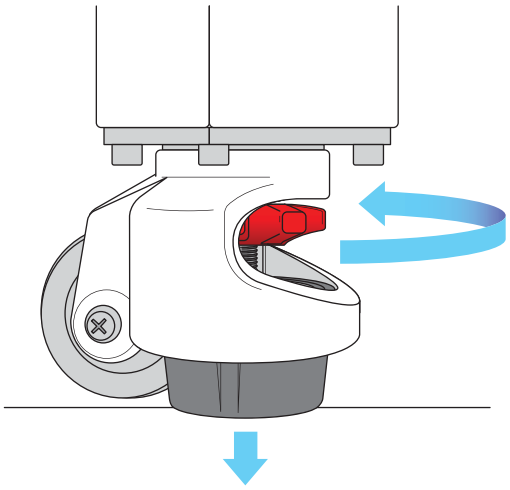
If the docking table is equipped with leveling casters, the docking and undocking processes are performed manually.

Docking a table with leveling casters

To dock a table with leveling casters:

1 Position the docking table adjacent to the system.

2 Turn the red wheel counterclockwise to extend the foot at each caster. Make sure the table is level.



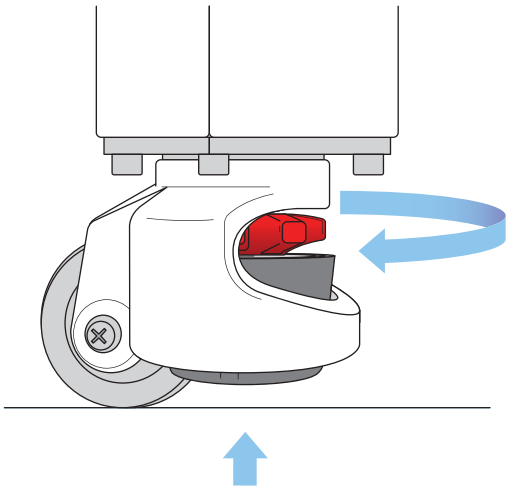
3 Follow instructions in one of the following sections to verify the teachpoints of the devices on the docking table:

- "Verifying Direct Drive Robot teachpoints" on page 90
- "Verifying 3-Axis Robot teachpoints" on page 124
- "Verifying KiNEDx Robot teachpoints and waypoints" on page 143

Undocking a table with leveling casters

To undock a table with leveling casters:

1 Turn the red wheel clockwise to raise the foot at each caster before moving the table.



2 Move the table away from the system.

Related information

For information about...	See...
Docking tables	"Docking tables (optional)" on page 9

For information about...	See...
Mounting devices on the docking table	Automation Solutions Technical Support
Devices that can be integrated in the BioCel System	“Device integration options” on page 23
Available devices	“Additional BioCel System Devices” on page 241

Checking for system readiness

Procedure

To check that the BioCel System is ready for a protocol run:

1. Remove labware at robot-accessible locations, including:
   - Platepads
   - External device plate stages
   - Third-party device areas that will accept labware from the BioCel System
2. Remove any obstacle in the robot's pathways.
3. Make sure all devices are set up correctly and prepared for the run. For instructions, see the user documentation for the device.
4. Make sure all devices are turned on, the compressed air is turned on, and the vacuum is turned on.

   For the devices that require compressed air, make sure the air pressures meet the operating requirements. For the BioCel System compressed air requirements, see "System specifications" on page 5. For other devices, see the user documentation for the device.
5. Turn on the safety interlock. For instructions, see "Startup procedure" on page 32.

Related information

For information about...	See...
Creating protocols	*VWorks Automation Control User Guide*
Starting, pausing, monitoring, and stopping protocol runs	*VWorks Automation Control User Guide*
Stopping a run in an emergency	*BioCel System Safety Guide*

Replacing the waste bin

About this topic

If the BioCel System has an optional waste bin, make sure you empty the bin before starting a protocol run. The waste bin can be free-standing or on a hanger. This section explains how to replace the waste bin on a hanger.

WARNING **If the BioCel System has an automatic door over the waste bin, use caution when removing or replacing the waste bin. If a protocol is running, the automatic door for the waste opening might open or close at any time. Do not attempt to retrieve or place the waste bin during a protocol run.**

Removing the waste bin

To remove the waste bin from its hanger:

1. Open the cabinet door nearest the bin.
2. Hold the bin at the top-right corner with your right hand.
3. Lifting the front side of the bin upwards with your right hand, place your left hand underneath at the bottom-left corner.
4. Supporting the bin with both hands, lift it up and off the hanger.
5. Slide the bin out of the BioCel System.
6. Close the cabinet door.

Installing the waste bin

To replace the waste bin on its hanger:

1. Open the cabinet door nearest the bin.
2. Slide the empty bin into the BioCel System until it lies underneath the waste opening, with the side of the bin resting against the hanger.
3. Lifting the front side of the bin upwards with your right hand, place your left hand underneath at the bottom left corner.
4. Using both hands, lift the bin up, over the hanger, and down so the hanger supports the underside of the lip.
5. Close the cabinet door.

Related information

For information about...	See...
BioCel System air source requirements	"System specifications" on page 5
External device air source requirements	External device user documentation
Diagnosing air pressure problems	"Troubleshooting hardware problems" on page 183

Loading labware in the system

When you need to manually load labware in the system

Depending on the protocol, you might need to manually place microplates, tipboxes, reservoirs, or counterweights onto platepads, hotel shelves, device shelves, or labware storage devices before starting the run. For example, you generally need to load labware into Labware Stackers or one or more cassettes (racks) in the Plate Hub Carousel.

How you load the labware in various devices depends on the type of robot in the system and the device. This topic provides the following:

- "Direct Drive Robot guidelines" on page 169
- "3-Axis Robot and KiNEDx Robot guidelines" on page 169
- "Plate Hotel and Plate Hub Carousel guidelines" on page 170

Direct Drive Robot guidelines

Before loading labware in storage devices, always review the teachpoint file for labware orientation information. The labware must be loaded in the same orientation as specified in the teachpoint file.

3-Axis Robot and KiNEDx Robot guidelines

In systems that use the 3-Axis Robot or the KiNEDx Robot, always load labware into storage devices so that the A1 well is in the top-left corner from the robot's perspective.

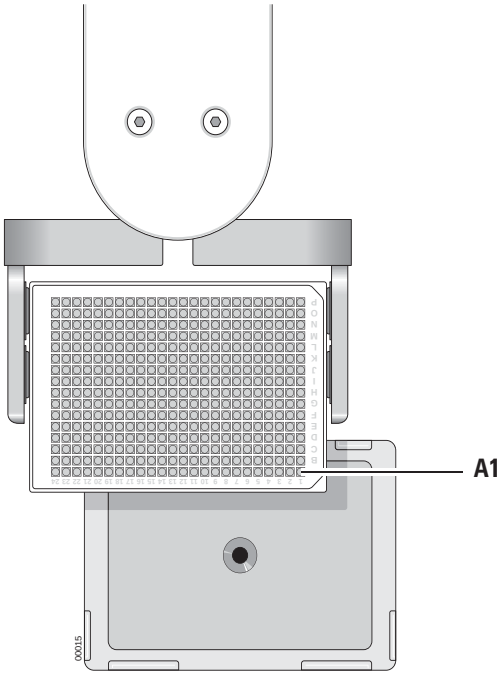


Plate Hotel and Plate Hub Carousel guidelines

Before you start

Before loading labware in the Plate Hotel and Plate Hub Carousel, make sure the racks and slots used in the protocol are defined in the Plate Hub Carousel profile. For detailed instructions, see "Plate Hotel and Plate Hub Carousel" on page 319.

Review the "Direct Drive Robot guidelines" on page 169 or "3-Axis Robot and KiNEDx Robot guidelines" on page 169 so that you know how the labware should be loaded.

Procedure

With the Plate Hotel or Plate Hub racks in the BioCel System, load labware into the slots.

IMPORTANT Although they are removable, Agilent Technologies recommends that you leave the Plate Hub Landscape racks in the BioCel System while loading labware. Doing so ensures the teachpoints are maintained and prevents potential spills in the hotel or carousel.

Related information

For information about...	See...
Plate Hotel and Plate Hub Carousel	"Plate Hotel and Plate Hub Carousel" on page 319
Direct Drive Robot teachpoints	"Direct Drive Robot teachpoints" on page 60

Stopping a run in an emergency

About this topic

You should know how to stop the run in case of an emergency. This topic explains how to stop the BioCel System in an emergency situation.

To pause and continue a run, use the Pause command in the VWorks software. You can also stop a run using the Stop command in the software. For instructions, see the *VWorks Automation Control User Guide*.

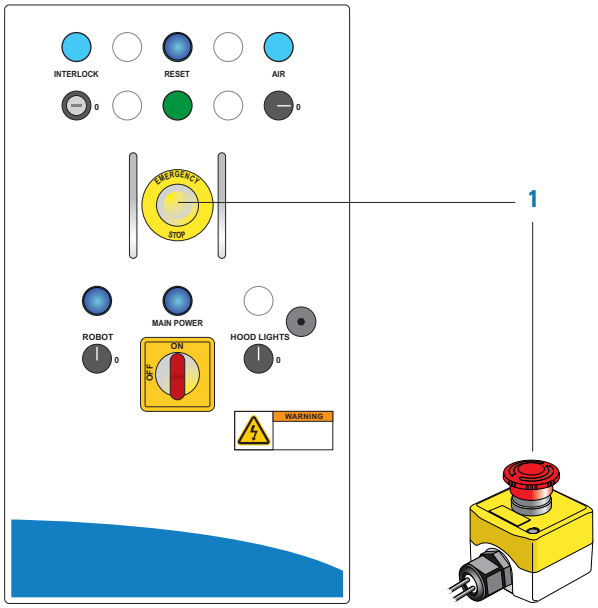
Using the EMERGENCY STOP button

CAUTION You cannot resume a protocol run after pressing the EMERGENCY STOP button.

To stop a protocol run in an emergency:

Press the EMERGENCY STOP button on the power panel or on the BioCel System table (1). The BioCel System robot stops immediately. The integrated devices stop immediately.

WARNING After you press the EMERGENCY STOP button, the Vertical Pipettor will finish the current task before stopping.



To restore the system for normal operation, see "Recovering from an emergency stop" on page 175.

Using the light curtains (BioCel 900 System only)

IMPORTANT Do not use the light curtains to routinely stop a protocol run. Instead, use the Pause or Stop command in the software.

To use the light curtain in an emergency:

1. Interrupt the light beams from the light curtains. The safety interlock circuit is interrupted. The BioCel System operation stops. The INTERLOCK indicator light on the power panel turns off.
2. To resume or recover from the stop, see "Recovering from an emergency stop" on page 175.

Related information

For information about...	See...
Recovering from an emergency stop	"Recovering from an emergency stop" on page 175
Shutdown procedure	"Starting up and shutting down the BioCel System" on page 32
General safety information	*BioCel System Safety Guide*

7 Maintenance and troubleshooting

This chapter explains how to maintain the BioCel System and provides troubleshooting information.

This chapter contains the following topics:

- "Routine maintenance" on page 174
- "Recovering from an emergency stop" on page 175
- "Recovering from a power outage" on page 179
- "Recovering from servo errors" on page 180
- "Troubleshooting plate-sensor errors" on page 182
- "Troubleshooting hardware problems" on page 183
- "Troubleshooting error messages" on page 189
- "Reporting problems" on page 203

Routine maintenance

About this topic

This topic provides recommendations for maintaining the BioCel System. For the maintenance of integrated devices, see the user documentation for the devices.

General maintenance

In general, practice good housekeeping by cleaning up spills and following the post-run clean-up procedures.

Cleaning up after every protocol run

To clean up after a run:

1. Follow the VWorks software prompts for post-run procedures, such as unloading the labware. See the *VWorks Automation Control User Guide* for detailed instructions.
2. Unload used labware from the devices.
3. Remove manually placed labware from devices.
4. See the device user documentation for cleanup instructions.
5. Check run logs for errors.
6. If you have administrator or technician privileges and you have modified the protocol, including selected options, you can save the protocol.
7. Log out of the software. See the *VWorks Automation Control User Guide* for instructions.

Monthly inspection and maintenance

Once a month, check the following:

- Robot gripper pads are not torn, cracked or otherwise worn. To replace the robot gripper pads, contact Automation Solutions Technical Support.
- Liquid-handling tubing is not torn, cracked or discolored. See the liquid-handling device user documentation for detailed instructions.
- Table top is free of debris, such as pieces of chipped microplates and microtubes.

Related information

For information about...	See...
Shutdown procedure	"Shutting down procedure" on page 36
Safety	*BioCel System Safety Guide*
Reporting problems	"Reporting problems" on page 203

Recovering from an emergency stop

About this topic

This topic explains how to recover from an emergency stop after you:

- Pressed the EMERGENCY STOP button on the power panel or on the system table
- Interrupted the light beams in the light curtains

After you pressed the EMERGENCY STOP button

After pressing the Emergency Stop button, you must restore the system for normal operation.

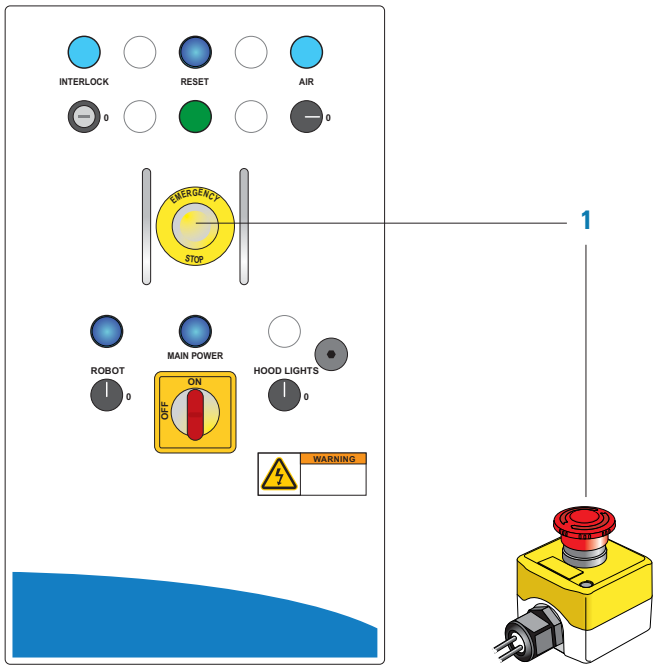
IMPORTANT You cannot resume or recover a protocol run after pressing the Emergency Stop button on the power panel or on the BioCel System table. You will need to rerun the protocol after restoring the system for normal operation.

Before you restore the system, make sure you remove labware that was dropped during the emergency stop. Also remove labware at teachpoints or other locations.

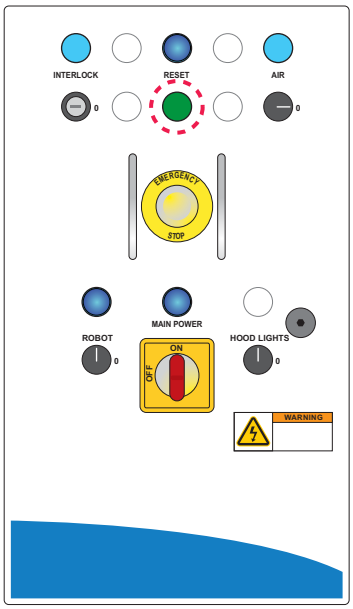
To restore the BioCel System after an emergency stop:

1 Restore power and air to various system components. To do this:

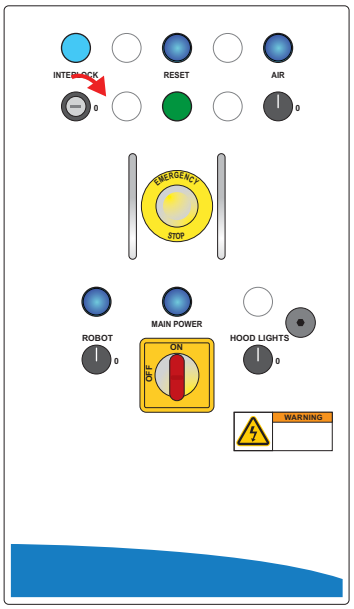
- On the power panel, pull out the **EMERGENCY STOP** button.
- On the BioCel System table, turn the **EMERGENCY STOP** buttons clockwise. The spring-loaded buttons pop up.



2 On the power panel, press the green **RESET** button.



3 If the BioCel System has light curtains, turn off the safety interlock. To do this, on the power panel, turn the **INTERLOCK** key clockwise. The INTERLOCK indicator light turns off.



4 In each of the device dialog boxes opened in the software, select one of the following commands to restore the device for normal operation. For example, you might need to use the device diagnostics software to release labware, replace the lid on a labware, home the robot, or verify the device teachpoint.

Selection	Description
Diagnostics	Opens the device diagnostics dialog box. *Note:* This selection is available only when you are in the middle of a protocol run and not while you are already in the device diagnostics software.
Retry	Attempts to restart the current command or task in the run.
Ignore and continue	Ignores the current command or task and continues to the next command or task in the protocol sequence.
Abort	Aborts the current command or task in the run. Select Abort if you have determined that the protocol run is not recoverable.

5 If there is labware in the BioCel System robot gripper, release it and move it back to the pickup location. To do this:

- **a** Determine the location from which the labware was picked up.
- **b** In the **Robot Error** dialog box, click **Diagnostics.**
- **c** Hold the labware in your hand so that the labware does not drop when you release it from the robot grippers.
- **d** Click **Open Gripper** to release the labware to your hand.
- **e** Place the labware at the pickup location.

6 If the BioCel System has light curtains, turn on the safety interlock. To do this, on the power panel, turn the **INTERLOCK** key counterclockwise.

7 Click **Abort Process** in the **Stop** dialog box.

8 Exit and restart the VWorks software. Communication with the devices that lost power is re-established.

After you interrupted the Light Curtain

If you interrupted the light beams in the Light Curtains during a protocol run, the Scheduler Paused dialog box opens in the VWorks software.

To resume the run or recover the system after interrupting the light beams in the Light Curtains:

1 In the VWorks software, click one of the following in the **Scheduler Paused** dialog box:

Selection	Description
Continue	Ignores the current command or task and continues to the next command or task in the protocol sequence.

Selection	Description
Diagnostics	Allows you to select the device and opens the device diagnostics dialog box. *Note:* This selection is available only when you are in the middle of a protocol run and not while you are already in the device diagnostics software.
Abort process	Aborts the current command or task in the run. Select Abort if you have determined that the protocol run is not recoverable.

2 In the **Robot Error** dialog box, click one of the following:

Selection	Description
Diagnostics	Opens the device diagnostics dialog box. *Note:* This selection is available only when you are in the middle of a protocol run and not while you are already in the device diagnostics software.
Retry	Attempts to restart the current command or task in the run.
Ignore and continue	Ignores the current command or task and continues to the next command or task in the protocol sequence.
Abort	Aborts the current command or task in the run. Select Abort if you have determined that the protocol run is not recoverable.

Related information

For information about...	See...
Pausing and resuming protocol runs	*VWorks Automation Control User Guide*
Shutting down the system	"Shutting down procedure" on page 36
Using commands in Robot Diagnostics	"Using diagnostic tools" on page 205
Safety	*BioCel System Safety Guide*
Reporting problems	"Reporting problems" on page 203

Recovering from a power outage

About this topic

This topic explains how to recover the BioCel System from a power outage.

During the power outage

During a power outage, if the BioCel System has a UPS, the following occurs:

- The UPS starts to beep while providing power to the devices.
- The VWorks software writes an error message to the log, displays an error message on the screen, and notifies you if you have specified email notification during setup.
- If the system is running a protocol, it will continue until the UPS charge passes the thresholds specified in VWorks software. When the threshold is reached, the VWorks software exits and the computer shuts down automatically.

If the BioCel System does not have a UPS, the system stops during a power outage. If the system is running a protocol, the run stops.

Recommended actions during a power outage (systems with UPS only)

If a running protocol is nearly finished, you might consider letting it continue until it is finished.

If you started running a protocol and you anticipate a lengthy power outage, you might consider stopping the run.

When the power is restored

If the BioCel System was not shut down during the power outage, the system will receive power, the UPS recharges, and the protocol (if running) continues.

If the BioCel System does not have a UPS and the running protocol was stopped, you need to restore the system and rerun the protocol. Follow the instructions in "Recovering from an emergency stop" on page 175 to restore the system.

Related information

For information about...	See...
Setting the VWorks software UPS threshold	*VWorks Automation Control User Guide*
Turning on the BioCel System	"Starting up and shutting down the BioCel System" on page 32
Safety	*BioCel System Safety Guide*
Reporting problems	"Reporting problems" on page 203

Recovering from servo errors

About this topic

This topic explains how to recover from servo errors.

Causes of servo errors

A servo system controls the robot's motions. The servo cuts power to the robot if it encounters resistance to movement that is slightly higher than that expected from the inertia of the robotic arm holding a labware. When the power is cut, a servo error is generated.

Most servo errors occur when the labware being carried crashes into another labware that is on a device.

Procedure

To recover from a servo error:

1. Check the BioCel System table to determine the cause of the collision and remove the obstruction. For example, it might be a labware from a previous run.
2. Check the labware that is held by the robot to make sure it is not damaged and that its contents are not spilled.
3. Make sure the labware did not move in the robot gripper during the collision.
4. If the labware has not moved in the robot gripper and was not damaged during the collision, in the error message dialog box, click one of the following:

Selection	Description
Diagnostics	Opens the device diagnostics dialog box. *Note:* This selection is available only when you are in the middle of a protocol run and not while you are already in the device diagnostics software.
Retry	Attempts to restart the current command or task in the run.
Ignore and continue	Ignores the current command or task and continues to the next command or task in the protocol sequence.
Abort	Aborts the current command or task in the run. Select Abort if you have determined that the protocol run is not recoverable.

5 If the labware has moved during the collision or was damaged, in the error message dialog box, click **Diagnostics** and move the labware manually:

   a Move the robot to a position that is easy for you to access.

   b While holding the labware with your hand, in the diagnostics software, use the available software command to open the robot grippers. The robot releases the labware. For diagnostics software instructions, see "Using diagnostic tools" on page 205.

   c Place the labware at the destination location manually.

   d Close the robot diagnostics software.

   e Click in the next error message dialog box, click **Ignore and continue.**

6 If the crash was severe, home the robot. To do this, in the robot diagnostics software, use the available command to home the robot. For diagnostics software instructions, see "Using diagnostic tools" on page 205.

Related information

For information about...	See...
Emergency stop circuits	"Power system" on page 348
Power panel	"Power panel" on page 7
Verifying teachpoints	One of the following: • "Verifying Direct Drive Robot teachpoints" on page 90 • "Verifying 3-Axis Robot teachpoints" on page 124 • "Verifying KiNEDx Robot teachpoints and waypoints" on page 143
Reporting problems	"Reporting problems" on page 203

Troubleshooting plate-sensor errors

About this topic

This topic explains how to troubleshoot plate-sensor errors in systems that have the 3-Axis Robot.

Procedure

To troubleshoot a plate-sensor error:

1 If the robot is not holding labware in the gripper, determine whether the labware was:

- Knocked out of the gripper. In this case, find out what knocked the labware out of the gripper.
- Missing from the location at which the robot attempted to pick it up. In this case, place the correct labware in the location and click **Retry** in the **Robot Error** dialog box.
- Not picked up. In this case, there might be a problem with either the labware definition for the labware or a teachpoint. Check the labware definition. Check the teachpoint at the position where it failed to pick up the labware, and the teachpoint at the previous position. If there does not seem to be a teachpoint error, contact Automation Solutions Technical Support.

2 If the labware is held in the gripper but is not seated correctly, establish whether the labware was positioned correctly at the pickup location.

- If the labware was not positioned correctly at the pickup location, reposition the labware and click **Retry** in the **Robot Error** dialog box.
- If the labware was positioned correctly at the pickup location, there might be a problem with the approach or departure height. Alternatively, there might be a problem with the labware, the labware definition, a teachpoint, or the plate sensor. In this case, you should contact Automation Solutions Technical Support.

Related information

For information about...	See...
Emergency stop circuits	"Power system" on page 348
Verifying teachpoints	One of the following: • "Verifying Direct Drive Robot teachpoints" on page 90 • "Verifying 3-Axis Robot teachpoints" on page 124 • "Verifying KiNEDx Robot teachpoints and waypoints" on page 143
Reporting problems	"Reporting problems" on page 203

Troubleshooting hardware problems

About this topic

This topic lists possible hardware problems, the causes of the problems, and ways to resolve the problems. If you are still experiencing problems with the BioCel System after trying the solutions, contact Automation Solutions Technical Support.

Note: This topic presents problems and solutions that are specific to the Direct Drive Robot, 3-Axis Robot, and KiNEDx Robot. Problems and solutions that are common in the three robots and the Staubli Robot are also presented. For problems specific to the Staubli TX60 Robot, see the *Staubli TX60 Device Driver User Guide.*

Hardware problems

Problem	Cause	Solution
The system does not turn on.	The system electrical requirements are not met.	Make sure the system electrical requirements are met. See "Electrical requirements" on page 5.
	The BioCel System is not connected to the power source.	Connect the BioCel System to the power source. See "Power connection" on page 14.
	The power supply circuit breaker switches have been tripped.	Reset the circuit breakers. If the switches continue to trip, check and make sure the system electrical requirements are met. See "Electrical requirements" on page 5.
	The UPS is not turned on or is not working properly.	Turn on the UPS. See "Starting up and shutting down the BioCel System" on page 32.
	The internal fuse is blown.	Contact Automation Solutions Technical Support.
A hissing sound can be heard.	A leak is present in the air connection or inside the system.	Turn off the air at the power panel ("Power panel" on page 7) and the utilities panel ("Air regulation panel" on page 11). Check the air connections at the utilities panel and at the source (house, cylinder, or pump). If the connections look fine, the leak might be inside the system. Contact Automation Solutions Technical Support.
Oil is present inside devices or the system.	The compressed air is not from an oil-free compressor and oil has leaked into the system.	Contact Automation Solutions Technical Support.

Problem	Cause	Solution
Labware drops or is held loosely by the robot.	*Direct Drive Robot.* • The labware definition for the microplate type might contain incorrect information. • The Grip torque parameter value is incorrect for the labware. • The Gripper offset range in incorrect. • The robot gripper pads are dirty. • The grippers are damaged.	*Direct Drive Robot.* • Check the labware definition for errors. • In Labware Editor, change the Grip torque value for the labware. • In the Labware Editor and the DDR Diagnostics, change the Gripper Offset Range values. • Clean the robot gripper pads. • Call Automation Solutions Technical Support to replace the damaged robot grippers.
	3-Axis Robot, KiNEDx Robot, and Staubli robot. • The labware definition for the microplate type might contain incorrect information. • The system air pressure is too low or too high, or the air is turned off.	*3-Axis Robot, KiNEDx Robot, and Staubli Robot.* • Check the labware definition for incorrect information. • Check the air pressure and connections at the utilities panel and at the source (house, cylinder, or pump). If the air is turned off, turn on the air. • If the air is turned on, adjust the system air pressure. If the grippers are bent outward from the labware, the pressure is too high. See "Air regulation panel" on page 11 for the location of the air pressure gauge. See "Compressed air requirements" on page 5 for air pressure specifications.
Labware bends when held by the robot.	*Direct Drive Robot.* The Grip torque parameter value is incorrect for the labware.	*Direct Drive Robot.* In Labware Editor, change the Grip torque value for the labware.
	3-Axis Robot, KiNEDx Robot, and the Staubli Robot. The system air pressure is too high so that the robot is holding the labware too tightly.	*3-Axis Robot, KiNEDx Robot, and Staubli Robot.* Decrease the system air pressure. See "Air regulation panel" on page 11 for the location of the air pressure gauge. See "Compressed air requirements" on page 5 for air pressure specifications.

Problem	Cause	Solution
The robot is not moving to and from the teachpoints accurately.	*All robots.* The robot axes need to be recalibrated.	*All robots.* Home the robot. See one of the following: • "Homing the Direct Drive Robot and grippers" on page 207 • "Homing the 3-Axis Robot" on page 230 • "Homing the KiNEDx Robot" on page 238 • *Staubli TX60 Device Driver User Guide*.
	All robots. The teachpoint coordinates or orientations are inaccurate. The approach height value might be incorrect.	*All robots.* Verify and edit the teachpoint. See one of the following: • "Verifying Direct Drive Robot teachpoints" on page 90 • "Verifying 3-Axis Robot teachpoints" on page 124 • "Verifying KiNEDx Robot teachpoints and waypoints" on page 143 • *Staubli TX60 Device Driver User Guide*.

Problem	Cause	Solution
The robot is unable to place labware at the target location accurately.	*All robots.* • The target location teachpoint is incorrect. • The teachpoint of the previously scheduled device is incorrect. • The target device was moved or reconfigured and the teachpoint was not updated. • Approach height setting is incorrect. • The labware might be damaged or deformed. • The robot gripper pads are dirty. • The robot gripper pads are worn unevenly or are damaged.	*All robots.* Verify and edit the teachpoints. See one of the following: • "Verifying Direct Drive Robot teachpoints" on page 90 • "Verifying 3-Axis Robot teachpoints" on page 124 • "Verifying KiNEDx Robot teachpoints and waypoints" on page 143 • *Staubli TX60 Device Driver User Guide*. • Check the approach height setting. • Clean the robot gripper pads. • Replace the damaged or deformed labware. Contact Automation Solutions Technical Support to replace the robot grippers pads or the robot grippers.
	Direct Drive Robot. Incorrect gripper offset range is specified.	*Direct Drive Robot.* Check and correct the gripper offset ranges for the labware, the pick location, and the place location. See "Setting the gripper offset parameters" on page 83.
Direct Drive Robot only. The robot placed the labware such that the A1 well is in the wrong orientation.	*Direct Drive Robot.* The incorrect A1-well orientation is specified for the teachpoint.	*Direct Drive Robot.* In the teachpoint file, verify the A1-well orientation specification. Change the specification if necessary. See "Specifying the A1-well orientation" on page 74.
Direct Drive Robot only. The robot collides with devices or obstacles when moving from teachpoint to teachpoint.	*Direct Drive Robot.* The incorrect robot-arm orientation, approach height, or approach distance values are used.	*Direct Drive Robot.* In the teachpoint file, check and correct the robot-arm orientation, approach height value, and approach distance value. See "Creating a new teachpoint" on page 74.

Problem	Cause	Solution
The Lid Hotel Station is not delidding or relidding properly.	• The rollers in the Lid Hotel Station are dirty. • The robot is holding the labware at the lid instead of below at the microplate. • Barcode labels are applied to the lid and the labware, preventing the lid from being removed. • Too many layers of barcode labels are applied to the labware. • The lids have sticky residues from the barcode labels.	• Clean the rollers in the Lid Hotel Station. • Check and adjust the robot gripper offset for the labware. • Check how the barcode labels are applied to the labware. Make sure the labels are applied correctly. • Remove excess layers of old barcode labels before applying new labels. • Clean the barcode label residues from the labware lids.
The Vacuum Delid Station is not working properly.	Air flow to the Vacuum Delid Station is insufficient.	• Check the air pressure and connections at the utilities panel and at the source (house, cylinder, or pump). • Check for leaks in the air supply line.
	Holes in the black rubber suction cups are causing vacuum leaks.	Contact Automation Solutions Technical Support to replace the black rubber suction cups.
	The Vacuum Delid Station teachpoint is incorrect.	Check and correct the teachpoint. Make sure you check the approach height value. *Direct Drive Robot*. Check the approach distance value and the custom action selected. See "Setting the approach distance" on page 81 and "Selecting custom actions" on page 84.

Related information

For information about...	See...
BioCel System component names	“Hardware overview” on page 7
Software error messages	“Troubleshooting error messages” on page 189
Diagnosing problems	“Using diagnostic tools” on page 205
Reporting problems	“Reporting problems” on page 203

Troubleshooting error messages

About this topic

This topic lists the following:

- DDR error messages
- 3-Axis Robot error messages

If the BioCel System has the KiNEDx Robot, see the Peak KiNEDx Robot user documentation for maintenance and troubleshooting instructions. For problems specific to the Staubli TX60 Robot, see the *Staubli TX60 Device Driver User Guide.*

DDR error messages

The following table lists error messages that might appear in DDR Diagnostics, the causes of the errors, and ways to resolve the errors. If you are still experiencing problems with the BioCel System after trying the solutions, contact Automation Solutions Technical Support.

For protocol-related errors, see the *VWorks Automation Control User Guide*.

The following error messages are listed by error message ID.

ID	Error message	Cause	Solution
124	The current speed setting <*speed*> exceeds the maximum speed specified by the newly selected labware <*speed*>. Would you like to reduce the speed setting to match the maximum speed <*speed*>?	After selecting a speed in DDR Diagnostics, you select a labware. The speed setting of the labware (in Labware Editor) is slower than the speed selection in DDR Diagnostics.	Select **Yes** to change the speed selection in DDR Diagnostics to match the labware speed setting. Select **No** to use the current speed selection in DDR Diagnostics. Note that the Labware speed setting will not be changed.
125	Failed to open a connection to <*profileName*: *errorString*>.	Connection cannot be established with the robot specified by the profile. The desired robot or the controlling computer is not connected to the system.	Make sure the robot and controller computer are both connected to the system network.
145	Failed to disable the arm power.	Connection cannot be established with the robot specified by the profile. The desired robot or the controlling computer is not connected to the system.	Make sure the robot and controller computer are both connected to the system network.
146	Failed to enable the arm power.	Connection cannot be established with the robot specified by the profile. The desired robot or the controlling computer is not connected to the system.	Make sure the robot and controller computer are both connected to the system network.

ID	Error message	Cause	Solution
167	Would you like to change the selected labware to Teaching Jig? If not, make sure the selected labware is gripped at its minimum gripper offset.	You clicked Teach Mode in DDR Diagnostics, but you have not yet selected the teaching jig.	Click **Yes** to select the teaching jig in DDR Diagnostics. Click **No** to exit the error dialog box. The existing labware is still selected. When using a labware to set teachpoints, the software assumes that the labware is held at the minimum gripper offset.
179	There are unsaved teachpoint modifications. Would you like to save?	While closing the profile, the software found unsaved teachpoint modifications.	Click **Yes** to save the changes and close the profile. Click **No** to close the profile without saving the changes.
212	This action will create <*orientation*>. This orientation already exists in this teachpoint. Would you like to exchange the parameters of these two orientations?	Changing the A1-well orientation of the selected orientation will result in duplicate orientations for a teachpoint.	Click **Yes** to keep the two A1-well orientations and exchange the parameters of these two orientations. Click **No** to exit the error dialog box without making any changes.
250	The teachpoint <*teachpoint name*> does not exist. Before starting the cycler, you must remove this teachpoint.	You are attempting to start the teachpoint cycler, but a teachpoint no longer exists. The teachpoints list in the Cycler tab is not synchronized with the teachpoints list in the Teachpoints tab. Teachpoints that were removed in the Teachpoints tab still appear in the Cycler tab.	Remove the obsolete teachpoint from the **Cycler** tab before starting the teachpoint cycler.
252	The center of the approach orientation <*plate, A1, and arm orientation*> is not within 25 mm of the center of the orientations found in the target teachpoint: <*teachpoint name*>. Continue?	All orientations of a single teachpoint should have the same center coordinates with a 25-mm tolerance along the *x*-, *y*-, or *z*-axis. The orientation you are adding is likely for a different teachpoint, because its center is greater than 25 mm from that of the target teachpoint.	Click **Continue** to add the orientation to the teachpoint despite the warning. When you save the teachpoint file, the same warning message will appear. Click **Cancel** to exit the dialog box without making the change.

ID	Error message	Cause	Solution
344	You are attempting to update the orientation <*original plate orientation, original A1 orientation, original arm orientation*> with the robot's current approach orientation: new plate orientation, new A1 orientation, new arm orientation. Because of this mismatch, the update is not allowed.	You moved the robot to a new position and the orientation (landscape/ portrait, right/left) does not match the teachpoint you selected for the update action. For example, the robot is currently in the landscape orientation but the teachpoint you selected has the portrait orientation.	Make sure you have selected the correct teachpoint for updating. Make sure you have moved the robot to the correct position and the orientation is correct.
363	Because the specified zip file name does not start with DDRFirmware, you cannot use this file to update the DDR firmware.	The .zip file you are using for firmware update must contain the DDRFirmware string in its name.	Make sure you selected the correct file for upgrading the firmware. The filename must start with the DDRFirmware string.
9041	Gripper motor could not initialize. If a plate is currently being gripped, removing it should allow the gripper motor to initialize.	The gripper was holding a labware when you initialized the robot.	Remove the labware, and then reinitialize.
9051	*z*-axis motor over temperature (digital).	The digital input that is connected to the *z*-axis temperature sensor indicates that this axis temperature is equal to or above approximately 110 °C.	Home the robot.
9052	*z*-axis motor over temperature (analog).	The analog input that is connected to the *z*-axis temperature sensor indicates that this axis temperature is equal to or above the factory-specified threshold.	Home the robot.
9081	Error while homing robot.	The robot grippers cannot move to the home position. An obstacle might be in the way, or the grippers are opened too far.	If the grippers are holding labware, remove the labware and retry homing. If an obstable is in the way, remove the obstacle and retry homing. Close the robot grippers and try again.
9082	Error while homing robot (fine homing error).	The robot is unable to move to the home position.	Move the robot to a different position, and then try to home the robot again.

ID	Error message	Cause	Solution
9115	Communication error (destination not set).	An internal software error occurred.	Contact Automation Solutions Technical Support.
9131	Teachpoint name not found.	An internal software error occurred.	Contact Automation Solutions Technical Support.
9132	Approach orientation index out of range.	An internal software error occurred.	Contact Automation Solutions Technical Support.
9138	Could not find the specified approach orientation.	The firmware has encountered a situation in which the desired approach orientation(s) does not exist in the specified teachpoint. For example, the operator has issued a 'Move to' command to teachpoint 'A', and specified that the Portrait, A1 away from the gripper, Lefty orientation be used. When the robot executes this command it is determined that the specified approach orientation does not exist for teachpoint 'A.'	Reset the teachpoint with the correct orientations.
9140	Final gripper position is less than target position.	The gripper settings need to be adjusted. When gripping a plate in landscape or portrait position, the gripper is closed until the labware-specified torque is reached. After reaching this torque, the grippers are stopped. The gripper position is checked against the Gripper settings found in the Setup tab. If the gripper position does not fall within the tolerance specified by these settings, this error is displayed.	In the **DDR Diagnostics Setup** tab, adjust the close target and the close tolerance settings.

ID	Error message	Cause	Solution
9141	Final gripper position is greater than target position.	The gripper settings need to be adjusted. When gripping a plate in landscape or portrait position, the gripper is closed until the labware-specified torque is reached. After reaching this torque, the grippers are stopped. The gripper position is checked against the Gripper settings found in the Setup tab. If the gripper position does not fall within the tolerance specified by these settings, this error is displayed.	In the **DDR Diagnostics Setup** tab, adjust the close target and the close tolerance settings.
9146	While picking: Error occurred during transfer from <*SRC*> to <*DST*>.	The robot was unable to move to the pick location because an obstacle was in the way.	Remove any obstacle in the robot's path and try again.
9147	While picking: Optical sensor failed to sense plate.	The software and firmware are out of date.	Update the DDR Diagnostics software to version 1.1 or later, and update the robot and gripper firmware to version 1.1 or later.
9149	Homing error: Home index pulse off.	Hardware error occurred in the motor, encoder, sensor, or all.	Contact Automation Solutions Technical Support.
9150	Homing error: Home index pulse on.	Hardware error occurred in the motor, encoder, sensor or all.	Contact Automation Solutions Technical Support.
9151	Homing error: Error on encoder falling edge.	Hardware error occurred in the motor, encoder, sensor or all.	Contact Automation Solutions Technical Support.
9152	Homing error: Error on encoder rising edge.	Hardware error occurred in the motor, encoder, sensor or all.	Contact Automation Solutions Technical Support.
9153	Homing error: Pulse width error found during homing.	Hardware error occurred in the motor, encoder, sensor or all.	Contact Automation Solutions Technical Support.
9154	Homing error: Error moving away from the latched position during homing.	An error occurred during the homing process.	Contact Automation Solutions Technical Support.

ID	Error message	Cause	Solution
9155	Homing error: Error moving off of index.	Hardware error occurred in the motor, encoder, sensor or all.	Contact Automation Solutions Technical Support.
9156	Homing error: Error finding next index.	Hardware error occurred in the motor, encoder, sensor or all.	Contact Automation Solutions Technical Support.
9157	Homing error: Via the look up table, the absolute position of the axis could not be determined. Move the robot to a new position and then retry homing.	Hardware error occurred in the motor, encoder, sensor or all.	Move the robot to a new position and try again.
9158	Homing error: Invalid state index specified.	Hardware error occurred in the motor, encoder, sensor or all.	Contact Automation Solutions Technical Support.
9161	Labware not present in grippers.	The software and firmware are out of date.	Update the DDR Diagnostics software to version 1.1 or later, and update the robot and gripper firmware to version 1.1 or later.
9163	Gripper was not empty when it should have been.	You issued a command that requires the robot to pick up a labware, but the robot is currently holding another labware.	Remove the labware from the robot's grippers and try again.
9164	Gripper should have been holding labware.	The software and firmware are out of date.	Update the DDR Diagnostics software to version 1.1 or later, and update the robot and gripper firmware to version 1.1 or later.
9165	Gripper servo error.	The robot bumped into an obstacle.	Remove all obstacles and try again. See the topic on recovering from servo errors.
9167	While picking: Error picking plate from <*SRC*>.	The software and firmware are out of date.	Update the DDR Diagnostics software to version 1.1 or later, and update the robot and gripper firmware to version 1.1 or later.
9180	Error while homing robot. Index transition was not found.	Hardware error occurred in the motor, encoder, sensor or all.	Move the robot to a new position and try again.
9183	The robot is in an indeterminate position.	Hardware error occurred in the motor, encoder, sensor or all.	Move the robot to a new position and try again.

ID	Error message	Cause	Solution
9203	Invalid secondary teachpoint specified for position interpolation.	While setting teachpoints for storage devices such as the Lid Hotel Station, an incorrect coordinate was used to determine the location of storage slots below the reference location (top-most platepad in the Lid Hotel Station).	Check the reference teachpoint, and then reset the teachpoints of the remaining storage slots.
9204	The position is outside the valid Z-axis range.	The robot is unable to move to the specified teachpoint. The specified gripper offset range results in a *z*-axis coordinate that is outside of the robot's physical limit.	Edit the teachpoint. Make sure the gripper offset range works with the desired *z*-axis coordinate.
9205	Invalid gripper offset setting.	The minimum offset value is larger than the maximum offset value.	Reset the gripper offset values.
9217	The gripper firmware is incompatible - please update your gripper firmware to the correct version.	You have updated the robot firmware, but have not yet updated the gripper firmware.	Update the gripper firmware. You must always update both firmware at the same time.
9224	Error while homing robot. Insufficient data found for commutation.	During homing of the waist, elbow, or wrist the homing process could not be completed.	Move the robot to a new position and try again.
9225	Z-axis commutation timed out.	The homing process is too long and timed out.	Move the robot to a new position and try again.
9242	While retracting after place: Error occurred during transfer from <*SRC*> to <*DST*>.	The robot was unable to retract to the safe zone because an obstacle was in the way.	Remove any obstacle in the robot's path and try again.
9244	While picking: The specified pick location would cause the robot to move beyond its limits.	The pick action requires that the robot move to a location that is out of the robot's reach.	Check and edit the teachpoint. Make sure the robot is able to reach the location.
9245	While placing: The specified place location would cause the robot to move beyond its limits.	The place action requires that the robot move to a location that is out of the robot's reach.	Check and edit the teachpoint. Make sure the robot is able to reach the location.
11028	Hard E-stop.	The Emergency Stop button was pressed.	See the topic that explains how to recover from an emergency stop. You cannot resume a run after an emergency stop.

ID	Error message	Cause	Solution
11028	Hard E-stop.	The Emergency Stop button was pressed, or something interrupted the light beams from the Light Curtain posts, breaking the safety circuit and disabling the robot motors.	If you pressed the emergency stop button, see the topic that explains how to recover from an emergency stop. If you interrupted the light curtain, remove obstacles that might be placed in the Light Curtain light paths, and then resume the run.
11610	Controller overheating.	The CPU exceeded its operating temperature for too long and the controller automatically turned off. If this occurs during a run, the run will automatically stop. The run cannot resume.	Wait approximatly 10 minutes for the robot to cool, power cycle the robot, and then try again.
11612	Power supply relay stuck.	The robot will not turn on.	Restart the robot. The power switch is on the front of the robot power supply. If restarting the robot does not help, the power supply unit might need to be replaced.
11613	Power supply shorted.	Power has been disabled because the motor power supply has detected that it is shorted.	The robot power supply unit might need to be replaced.
11614	Power supply overloaded.	Power has been disabled because the motor power supply has detected an overload condition.	The robot power supply unit might need to be replaced.
11615	Power supply reset stuck.	The robot motor power will not turn on.	Restart the robot. The power switch is on the front of the robot power supply. If restarting the robot does not help, the power supply unit might need to be replaced.
11616	Shutdown due to overheating.	The CPU exceeded its operating temperature for too long and the controller automatically turned off.	Wait approximatly 10 minutes for the robot to cool, power cycle the robot, and then try again.
13100	Position tracking error exceeded threshold.	The robot was unable to follow its intended trajectory, possibly because it bumped into an obstacle.	Remove all obstacles and try again.

ID	Error message	Cause	Solution
13104	Motor duty cycle exceeded.	An obstacle is preventing the robot from moving.	Remove all obstacles and try again.
13105	Motor stalled.	The robot bumped into an obstacle.	Remove all obstacles and try again.
13106	Axis over-speed.	This error is generated when power is enabled or during normal running if the system detects that an axis has violated a speed limit.	Remove all obstacles and try again.
13107	Amplifier over-current.	An obstacle is preventing the robot from moving.	Remove all obstacles, home the robot, and try again.
13109	Amplifier under-voltage.	The DC motor bus has dropped too low.	Check all cable connections. If the cables are correctly connected, the power supply might be be failing. In the **DDR Diagnostics Advanced** tab, note the **Bus Voltage** values and report the values to Automation Solutions Technical Support.
13113	Motor commutation setup failed.	The configuration files are corrupted.	Click Retry in the error dialog box.
13117	Amplifier RMS current exceeded.	An obstacle is preventing the robot from moving.	Remove all obstacles and try again.
13122	Position tracking error exceeded threshold.	The robot was unable to follow its intended trajectory, possibly because it bumped into an obstacle.	Remove all obstacles and try again.

3-Axis Robot error messages

The following table lists error messages that might appear in 3-Axis Robot Diagnostics, the causes of the errors, and ways to resolve the errors. If you are still experiencing problems with the BioCel System after trying the solutions, contact Automation Solutions Technical Support.

For the list of error message that might appear during a protocol run, see the *VWorks Automation Control User Guide*.

The following error messages are listed alphabetically within each category:

- During initialization
- During operation

During initialization

The following error messages are displayed during the initialization process.

Error message	Cause	Solution
Could not open robot COM port.	Another program is using the robot's COM port.	Quit the program that is using the COM port. If necessary, restart the VWorks software. If the problem continues, contact Automation Solutions Technical Support.
Could not open BCR COM port.	Another program is using the BioCel System barcode reader COM port.	Quit the program that is using the COM port. If necessary, restart the VWorks software. If the problem continues, contact Automation Solutions Technical Support.
Could not communicate with the robot.	The robot is not connected to the controlling computer.	Check that the robot is connected to the controlling computer.
	The incorrect profile is used.	In the 3-Axis Robot Diagnostics Profiles tab, make sure the correct profile is selected.
Could not communicate with robot during firmware version query.	The robot is not connected to its power source or is not turned on.	Make sure the robot is connected to its power source. Make sure the robot is turned on. If the problem persists, contact Automation Solutions Technical Support.
	The Agilent Technologies macros are not loaded into the robot.	Load the macros in the robot. For details, contact Automation Solutions Technical Support.
Could not communicate with robot during macro file query.	The software is unable to locate the correct macro file.	Contact Automation Solutions Technical Support.
Incorrect macro file loaded in robot.	The upgraded robot ActiveX requires updated macros.	Contact Automation Solutions Technical Support to update the macros.

Error message	Cause	Solution
Error retrieving robot status.	The robot returned a response not recognized by the software.	Contact Automation Solutions Technical Support.
A servo error occurred during homing.	The robot was unable to move to its home position, because something is blocking its path.	Remove any obstacles in the robot's path and retry the initiation procedure. If the problem persists, contact Automation Solutions Technical Support.
Timeout waiting for robot to home.	The robot did not reach its home position in the time expected.	Make sure obstacles are not preventing the robot from moving. Retry the command. If the problem persists, contact Automation Solutions Technical Support.

During operation

The following 3-Axis Robot Diagnostics error messages are displayed during diagnostic operation.

Error message	Cause	Solution
A robot macro did not complete execution.	The robot was commanded to carry out a task but did not signal that it has completed the task.	Retry the command. If the problem persists, contact Automation Solutions Technical Support.
Is <location> an illegal teachpoint? Check that z-height is within robot's work envelope.	The robot was asked to move to a location it cannot reach.	Check the teachpoint of the target location. Make sure the location is within the robot's workspace.
Time out waiting for teachpoint <teachpoint name> upload response.	The robot was commanded to carry out a task but did not signal that it has completed the task.	Retry the command. If the problem persists, contact Automation Solutions Technical Support.

Error message	Cause	Solution
Failed to sense plate when picking from <location>.	The labware was not in the robot's grips as expected because: • The labware might have been knocked out of the robot's grips. • The labware is missing at the expected location. • The robot did not pick up the labware.	Check the labware definition. Make sure the parameter values are set correctly for the particular labware. Check the teachpoint of the pickup location. Edit the teachpoint if necessary. Check that the labware is placed correctly at the teachpoint. Check the approach and departure height values. If the problem persists, contact Automation Solutions Technical Support.
	The plate sensor requires calibration.	Contact Automation Solutions Technical Support.
Could not retrieve status from robot.	The software is unable to receive robot status.	Make sure: • The system is turned on. • The communication hubs are turned on. • The communication cables between the robot and the computer are connected.
After placing at <location>, a plate was sensed in the gripper when it should be empty.	The robot air pressure might not be correct.	Check and adjust the air pressure to the robot. Make sure there are no leaks in the air line.
	The plate sensor requires calibration.	Contact Automation Solutions Technical Support.
A plate was not detected in the gripper during the place to <location>.	The robot air pressure might not be correct.	Check and adjust the air pressure to the robot. Make sure there are no leaks in the air line.
	The plate sensor requires calibration.	Contact Automation Solutions Technical Support.
After one failed delid attempt, the robot could not re-energize servos and retract the arm.	During delidding, the servo power to the robot died. The system automatically attempts to reactivate the servos but fails.	Restart the system. If the problem persists, contact Automation Solutions Technical Support.
A servo error occurred on: <location>.	Something is blocking the robot's path.	Remove obstacles in the robot's path.
	The robot is commanded to move faster than its capability given its current load.	Reduce the robot speed in the Labware Editor.

Error message	Cause	Solution
A servo error has occurred but it could not be determined which axis failed.	Something is blocking the robot's path.	Remove obstacles in the robot's path.
	The robot is commanded to move faster than its capability given its current load.	Reduce the robot speed in the Labware Editor.
Robot emergency stop or door interlock detected.	Something interrupted the light beams from the Light Curtain posts, breaking the safety circuit and disabling the robot motors.	Remove objects that might be placed in the Light Curtain light paths. See "Recovering from an emergency stop" on page 175.
	The Emergency Stop button is pressed.	See "Recovering from an emergency stop" on page 175.
The robot did not acknowledge that it completed its last move.	The robot did not signal that it has completed the task.	Retry the command. If the problem persists, contact Automation Solutions Technical Support.
Error resetting COM port.	The controlling computer cannot close and reopen the robot port.	Retry the command. If the problem persists, contact Automation Solutions Technical Support.
Regripping necessary, but the regripping station has not been taught.	The robot needs to regrip a labware, but the regripping station is not found.	Set the teachpoint for the regripping station.
The regripping station cannot be used as a pickup or dropoff location until it has been taught.	The robot needs to regrip a labware, but the regripping station is not found.	Set the teachpoint for the regripping station.
Lid detection error.	The incorrect labware type is used in the protocol.	Check the labware type used in the protocol.
	Lid Hotel Station sensors are not working.	Make sure the delidder device is connected to its power source. If it is, do the following: **1** Open the Lid Hotel Station Diagnostics. **2** Depress the delidder arms on the robot's left side. **3** Check and see if the status lights of the arms you pressed turn on. If the status lights do not turn on as you press them, contact Automation Solutions Technical Support.
	Lid Hotel Station teachpoints are incorrect.	Verify the Lid Hotel Station teachpoints. Edit them if necessary.

Related information

For information about...	See...
BioCel System component names	"Hardware overview" on page 7
Hardware problems	"Troubleshooting hardware problems" on page 183
Recovering from emergency stops	"Recovering from an emergency stop" on page 175
Recovering from power outage	"Recovering from a power outage" on page 179
Recovering from servo errors	"Recovering from servo errors" on page 180
Troubleshooting plate-sensor error	"Troubleshooting plate-sensor errors" on page 182
Safety	*BioCel System Safety Guide*
Reporting problems to Agilent Technologies	"Reporting problems" on page 203

Reporting problems

Contacting Automation Solutions Technical Support

If you find a problem with the BioCel System, contact Automation Solutions Technical Support at one of the following:

Europe

Phone: +44 (0)1763850230

email: euroservice.automation@agilent.com

US and rest of world

Phone: 1.800.979.4811 (US only) or +1.408.345.8011

email: service.automation@agilent.com

Note: You can also send a software bug report from within the VWorks software.

Reporting hardware problems

When contacting Agilent Technologies, make sure you have the serial number of the device ready.

Reporting software problems

When you contact Automation Solutions Technical Support, make sure you provide the following:

- Short description of the problem
- Software version number
- Error message text (or screen capture of the error message dialog box)
- Screen capture of the About VWorks software dialog box.
- Relevant software files

To find the VWorks software version number:

In the VWorks software, select **Help > About VWorks.**

To find the Diagnostics software version number:

1 Open **Diagnostics.**

2 Read the version number on the title bar of the diagnostics window.

To send compressed protocol and associated files in VZP format:

In the VWorks software, select **File > Export** to export and compress the following files:

- Protocol file
- Device file (includes the device profile and teachpoint file)
- Labware definitions
- Liquid classes
- Pipette techniques
- Hit-picking files

- Plate map files
- Barcode files
- Error library
- Log files
- Form file (*.VWForm)

Reporting user guide problems

If you find a problem with this user guide or have suggestions for improvement, send your comments using one of the following methods:

- Click the feedback button ( ) in the online help.
- Send an email to documentation.automation@agilent.com.

Related information

For information about...	See...
Hardware problems	"Troubleshooting hardware problems" on page 183
Software error messages	"Troubleshooting error messages" on page 189
Recovering from emergency stops	"Recovering from an emergency stop" on page 175
Recovering from power outage	"Recovering from a power outage" on page 179
Recovering from servo errors	"Recovering from servo errors" on page 180
Troubleshooting plate-sensor error	"Troubleshooting plate-sensor errors" on page 182
Safety	*BioCel System Safety Guide*

8 Using diagnostic tools

This chapter explains how to use the provided software tools to diagnose and troubleshoot the BioCel System.

Agilent Technologies recommends that only administrators and experienced personnel use the procedures in this chapter to diagnose problems with the BioCel System.

This chapter contains the following topics:

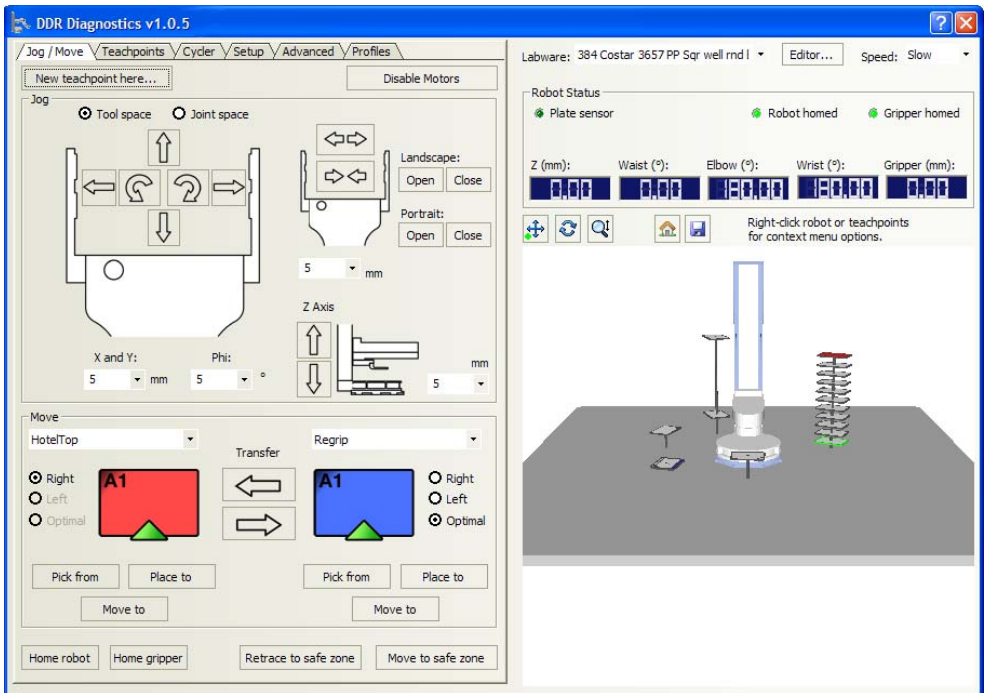
- "DDR Diagnostics" on page 206
- "3-Axis Robot Diagnostics" on page 229
- "KiNEDx Robot Driver Diagnostics" on page 237

For information about the Staubli robot, see the *Staubli TX60 Device Driver User Guide*.

DDR Diagnostics

About DDR Diagnostics

The DDR Diagnostics software allows you to control the motions of the Direct Drive Robot. The software has six tabs: Jog/Move, Teachpoints, Cycler, Setup, Advanced, and Profiles. You use the commands and parameters available in the these tabs to troubleshoot problems.



This topic explains the following:

- "Homing the Direct Drive Robot and grippers" on page 207
- "Moving the Direct Drive Robot into the safe zone" on page 208
- "Disabling and enabling the Direct Drive Robot motors" on page 210
- "Stopping the robot motors" on page 211
- "Changing the Direct Drive Robot speed" on page 211
- "Changing the robot speed definitions" on page 212
- "Jogging the Direct Drive Robot" on page 214
- "Opening and closing the Direct Drive Robot grippers" on page 216
- "Changing the gripper settings" on page 218
- "Checking the Direct Drive Robot microplate sensor" on page 220
- "Changing the Direct Drive Robot display" on page 221
- "Checking the temperature and bus voltage" on page 222
- "Restoring the robot settings" on page 223
- "Updating the firmware" on page 224
- "Backing up the robot firmware" on page 226

- "Restoring existing firmware" on page 226
- "Viewing the DDR Diagnostics log area" on page 228

See "Quick reference" on page 355 for the complete list of available commands you can use.

For instructions on setting and verifying teachpoints, see "Setting Direct Drive Robot teachpoints" on page 69.

For information about using the Profiles tab, see "Creating and managing Direct Drive Robot profiles" on page 47.

Homing the Direct Drive Robot and grippers

You can home the grippers independently of the robot.

Homing the robot

Homing the robot sends the robot to the factory-defined home position for each of the axes of motion. To home the grippers, see "Homing the robot grippers" on page 208.

Home the robot if you notice that the robot is not accurately picking up or placing labware. You might also want to home the robot after recovering from an emergency stop.

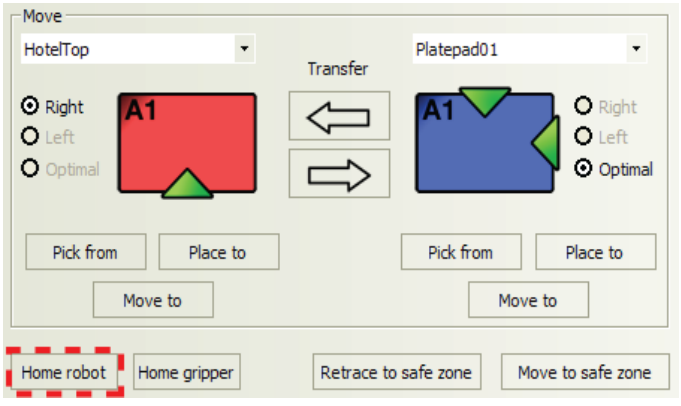
WARNING **Be sure to wear protective eyewear when entering the system and working with the robot.**

WARNING **Stay out of the system while the robot is in motion.**

Note: The robot homes automatically only when you initialize the robot. If the robot is already homed, the robot will skip the homing process during initialization.

To home the robot:

In the **Jog/Move** tab, click **Home robot.** The robot moves its joints until it finds the home position.



The homing process can take up to 2 minutes. During this time, the robot:

1. Checks for the presence of labware in its grippers. If labware is present, the software presents an error message. You must first remove the labware before homing.
2. Homes the grippers.
3. Looks for the home position for each joint (waist, elbow, and wrist) and moves to the home positions.
4. Looks for the home position along the *z*-axis and moves to the home position.

Note: If the robot hand is at the same height as the robot base, the robot will first raise the arm to clear the base before starting the homing sequence.

Homing the robot grippers

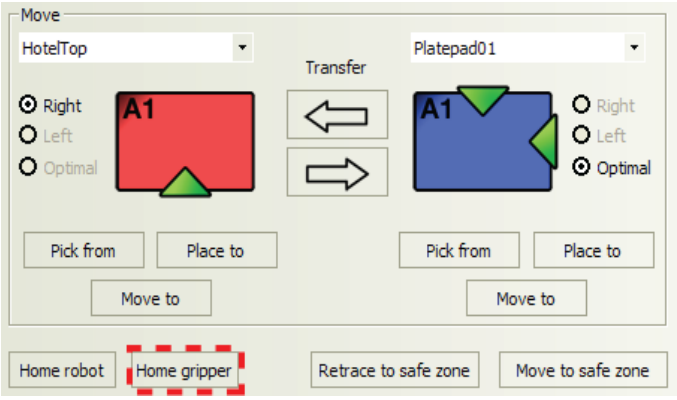
Homing the grippers does not home the rest of the robot.

WARNING **Be sure to wear protective eyewear when entering the system and working with the robot.**

WARNING **Stay out of the system while the robot is in motion.**

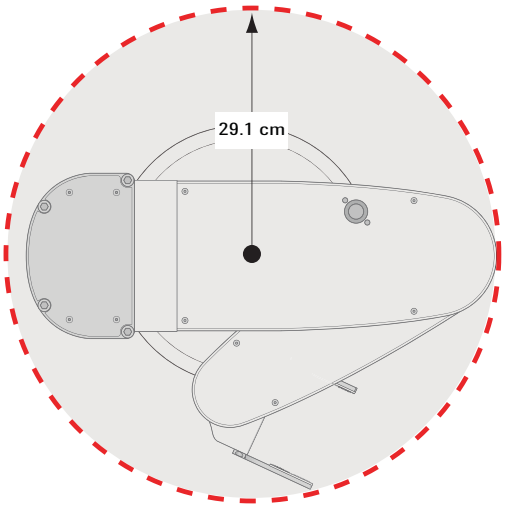
To home the robot grippers:

In the **Jog/Move** tab, click **Home grippers.** The robot opens and closes its gripers until it finds the home position.



Moving the Direct Drive Robot into the safe zone

The safe zone is the region within which the robot is allowed to move without colliding with external devices. For the Direct Drive Robot, it is the cylindrical region within the red-dotted line as shown in the following diagram. The radius of the cylinder, measured from the center of the base, is 29.1 cm (11.4 in).



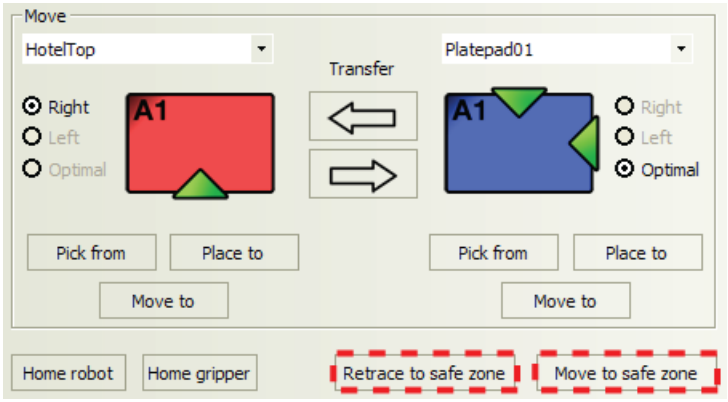
In general, the Direct Drive Robot moves into the safe zone after it completes a Move to, Pick from, Place to, or Transfer command. However, you can move the robot into the safe zone at other times to move it out of the way.

CAUTION Make sure you save new teachpoints in the teachpoint file before moving the robot. The robot can crash into devices at unknown (unsaved) teachpoints.

WARNING **Stay out of the system while the robot is in motion.**

To move the robot into the safe zone:

Click one of the following:



Command	Description
Move to safe zone	The robot searches for the closest teachpoint, and then uses the safest path from that teachpoint to the safe zone. If the robot is unable to find a teachpoint nearby, it retracts radially into the safe zone. Use the Move to safe zone command if it is close to a teachpoint and the path from that teachpoint to the safe zone is clear of obstacles.
Retrace to safe zone	The robot searches for the closest teachpoint, and then uses the path from that teachpoint to the safe zone. If the robot is unable to find a teachpoint nearby, it will retreat into the safe zone by retracing the path it took to reach the current location. Use the Retrace to safe zone command when, for example, the robot grippers are within a device, and using the Move to safe zone command might cause the robot to run into the sides of the device or other obstacles.

Disabling and enabling the Direct Drive Robot motors

Disabling the robot motors allows you to move the robot by hand. When you disable the robot motors, the robot will first finish the current command before stopping.

IMPORTANT You can disable the robot joint motors, but you cannot disable the *z*-axis motor. Therefore, you can move the robot by hand in the plane of the robot arm, but you cannot change its height.

Note: If the system is not running a protocol, and the robot remains inactive for 10 minutes, the motors are automatically disabled.

WARNING **The robot arm might move when the motors are being enabled. Stay out of the system when you enable the robot.**

To disable or enable the robot motors:

In the **DDR Diagnostics** **Jog/Move** tab, click **Disable Motors** or **Enable Motors.**

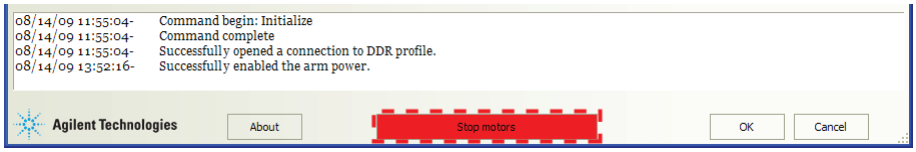
Stopping the robot motors

In an emergency, you can use the Stop Motors command to cut power to the robot motors, thus stopping the robot immediately.

To stop the robot motors:

In **DDR Diagnostics**, click **Stop Motors** at the bottom of the dialog box. The robot stops immediately.

Alternatively, if the pointer or cursor is not currently in any text box in the dialog box, you can press the space bar on the keyboard to stop the robot motors.



For information about using the emergency stop button on the power panel or the system table, see "Stopping a run in an emergency" on page 171.

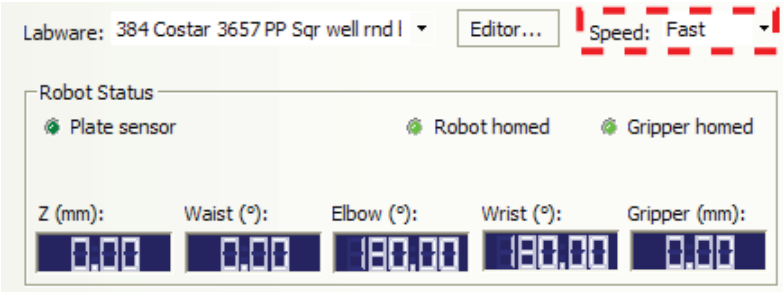
Changing the Direct Drive Robot speed

You can select the robot speed to accommodate the task you are performing. For example, you can select the Slow speed when you are creating new teachpoints or diagnosing problems with the system. When you are confident that problems are resolved and want to run a final check, you can select the Fast speed.

The speed you select in DDR Diagnostics applies only to the robot commands in DDR Diagnostics (jog direction, Move to, Pick from, Place to, and Transfer).

To select the robot speed:

In **DDR Diagnostics**, select one of the following from the **Speed** list: **Fast, Medium,** or **Slow.**



Note: During a protocol run, the robot will use the speed selection in the VWorks software Tools > Options dialog box. If the robot is holding a microplate, the slower of the following will be applied: the speed in the Labware Editor or the speed in the Tools > Options dialog box. For more information, see the *VWorks Automation Control Setup Guide* and *VWorks Automation Control User Guide*.

Changing the robot speed definitions

Three robot speeds (Fast, Medium, Slow) are available for selection in DDR Diagnostics, VWorks Options (under the Tools menu), and Labware Editor. You select a robot speed to accommodate the task you are performing. For example, you can select the Slow speed when you are creating new teachpoints, creating and testing protocols, or diagnosing problems with the system.

Each speed is defined as a percentage of the factory-set maximum speed. By default, the percentages are defined as follows:

Speed	Default
Slow	20%
Medium	50%
Fast	80%

You can change these speed definitions to accommodate your laboratory's needs.

IMPORTANT The speed definitions are universal and apply to the speeds you select in DDR Diagnostics, Labware Editor, and the VWorks Options dialog box.

Note: The speed you select in DDR Diagnostics applies only to the robot commands in DDR Diagnostics (Jog, Move, Transfer, and so on). If the robot is holding a labware, the slower of the following will be applied: the speed you selected in the Labware Editor, or the speed you selected in DDR Diagnostics.

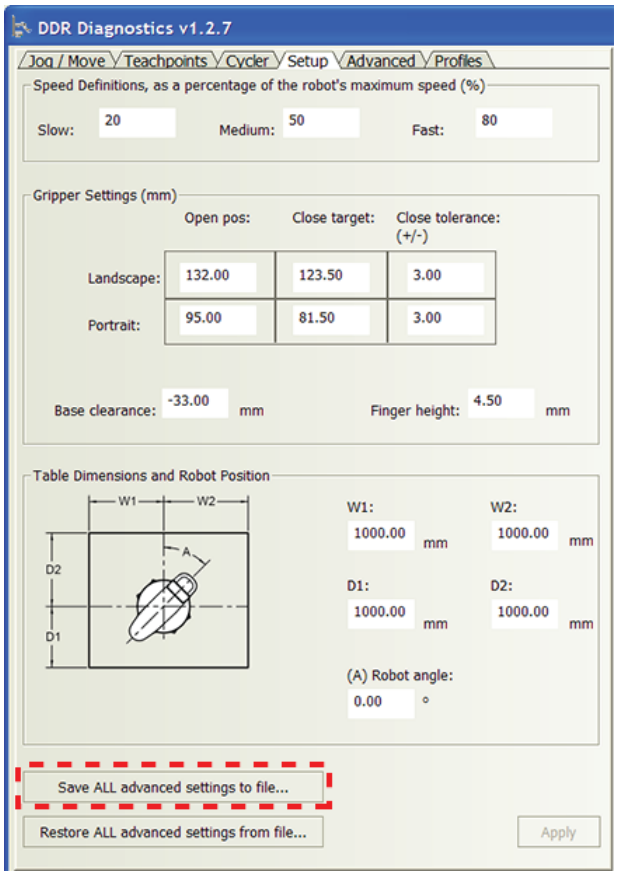
Similarly the speed selection in VWorks Options (under the Tools menu) applies to protocol runs. If the robot is holding a labware, the slower of the following will be applied: the speed you selected in the Labware Editor, or the speed you selected in VWorks Options.

Backing up existing settings

Agilent Technologies recommends that you back up the existing speed definitions before changing them.

To back up existing settings:

1 In the **DDR Diagnostics Setup** tab, click **Save ALL advanced settings to file.**



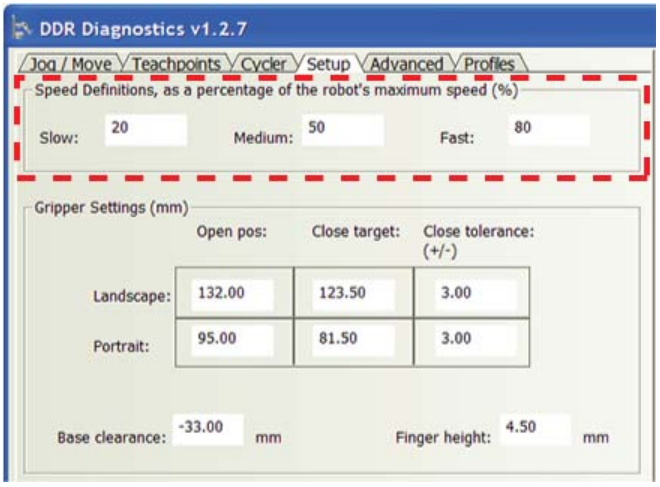
2 In the Save As dialog box that opens, type a name for the backup file. You can use the default backup file location, or select a different location. The default location is C:\Program Files\Agilent Technologies\Settings\DDR\FirmwareBackup.

3 Click **Save.** The robot settings are saved in an XML file.

Specifying new speed definitions

To change the speed definitions:

1 In DDR Diagnostics, click the **Setup** tab.



2 In the **Speed Definitions** area, type the new percentage for one or more of the speeds you want to re-define.

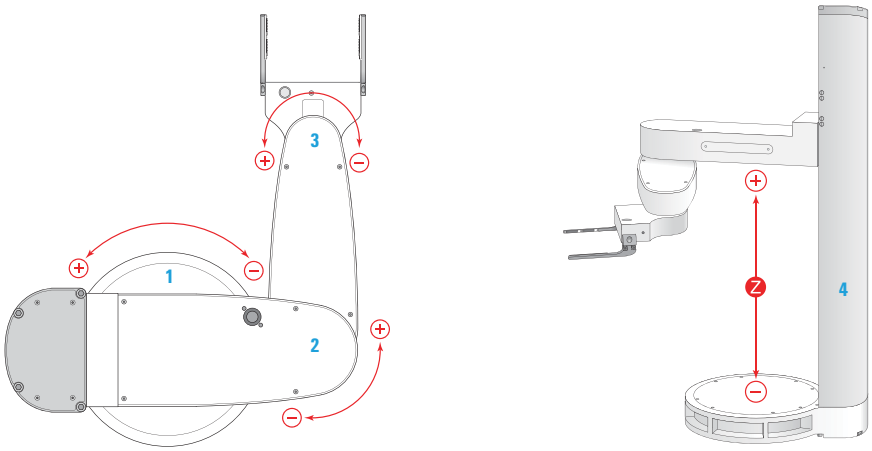
3 When you are finished, click **Apply.** The changes are saved to the firmware.

Jogging the Direct Drive Robot

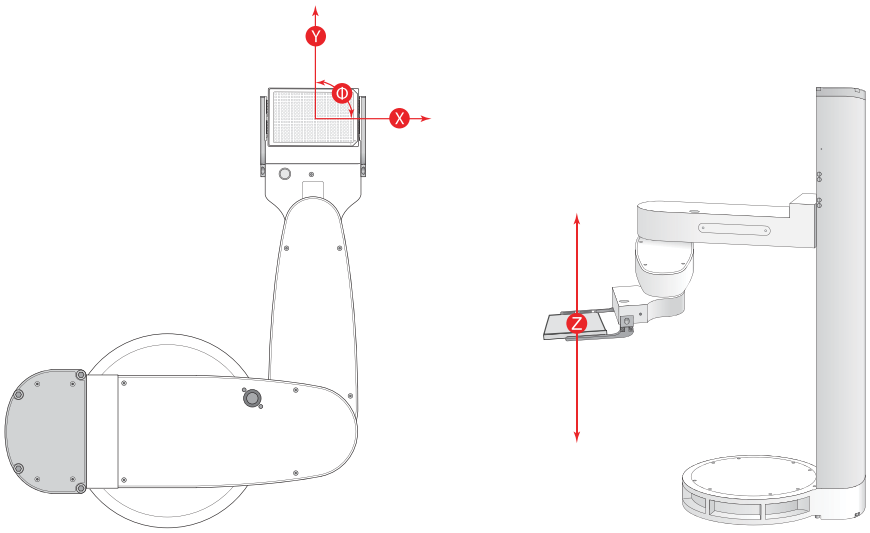
Jogging the robot moves the robot in small, precise increments. You can jog the robot to fine-tune its position when creating and editing teachpoints or during troubleshooting.

The Direct Drive Robot movements can be controlled or monitored from two different perspectives:

- *Joint space*. You can use a joint-space command to rotate the robot about its waist (1), rotate its forearm about the elbow (2), or rotate the hand about the wrist (3). In addition, you can move the robot arm up and down along the mast or *z*-axis (4).



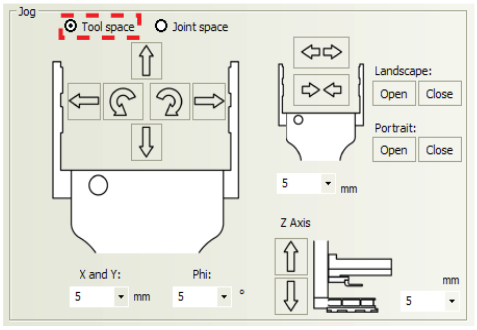
- *Tool space*. You can use a tool-space command to move a combination of robot joints so that the labware moves to its target location along the *x*- or *y*-axis. In addition, you can rotate the labware (*Phi* angle) and move the robot arm up and down along the mast or *z*-axis. In tool space, all movements are measured with respect to the center of the labware.



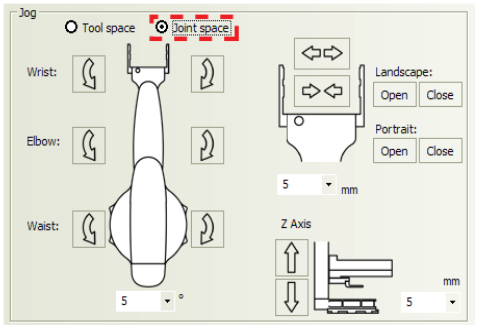
To select a perspective:

In the **Jog/Move** tab, select **Tool space** (1) or **Joint space** (2).

1



2

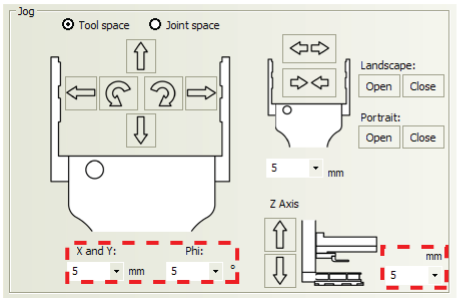


To jog the robot:

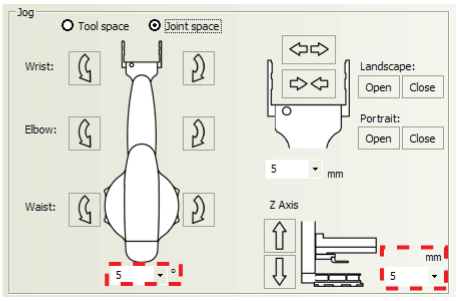
1 Select or type the jog increment for the axis or joint you want to move. The jog increments are in millimeters or degrees.

CAUTION Always select small jog increments so that the robot does not bump into obstacles in its path.

1



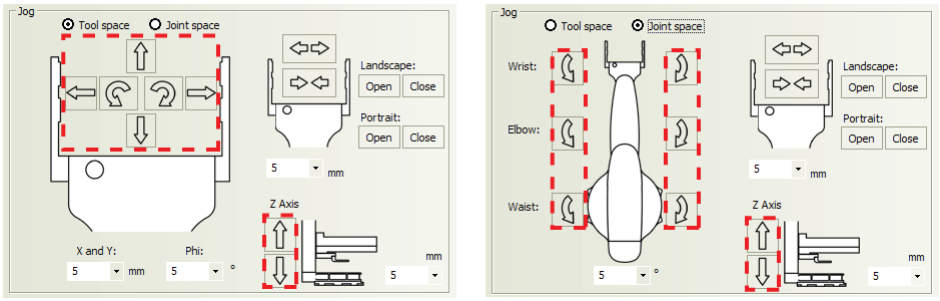
2



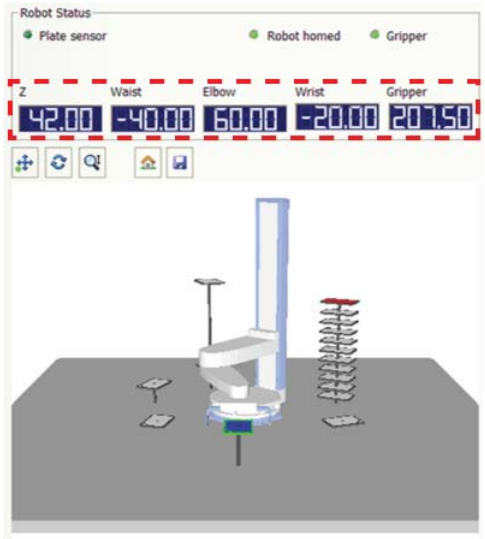
2 Click one of the jog direction buttons.

WARNING **Stay out of the system while the robot is in motion.**

1 2



In the **Robot Status** area, the current joint and *z*-axis coordinates are updated.



Opening and closing the Direct Drive Robot grippers

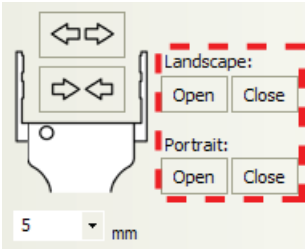
You can open the robot grippers to release labware. You can close the robot grippers to hold labware.

WARNING **Be sure to wear protective eyewear when entering the system and working with the robot.**

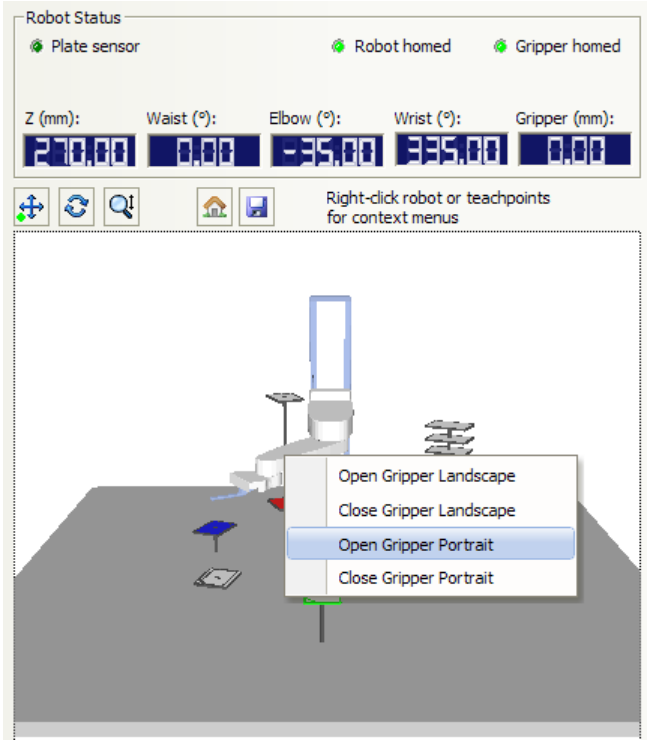
WARNING **Stay out of the system while the robot is in motion.**

To open or close the robot grippers:

In the **Jog/Teach** tab, click **Open** or **Close** for the desired orientation.



Alternatively, you can right-click the robot arm or mast in the Robot Status area, and then click the open or close gripper command for the desired orientation.

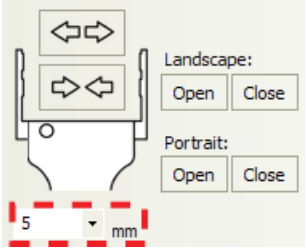


To open or close the grippers incrementally:

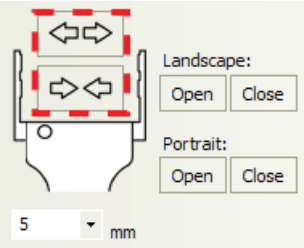
1 In the **Jog/Teach** tab, select or type the jog increment for the grippers.

CAUTION Always select smaller jog increments so that the robot does not bump into labware when it opens its grip, or bend the labware when it closes its grip.

IMPORTANT The jog increment applies to both grip directions.

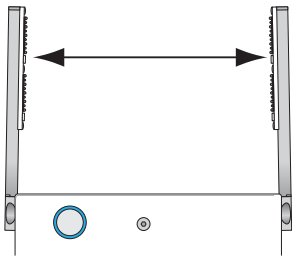


2 Click either the open or close gripper buttons.



Changing the gripper settings

The following gripper settings are set at the factory:

Gripper setting	Description
Open pos	The distance, in millimeters, between the grippers when they are open. The default values are: • 132 mm (landscape) • 95 mm (portrait) 
Close target	The approximate distance, in millimeters, between the grippers when they are closed. The default values are: • 123.5 mm (landscape) • 81.5 mm (portrait) The Close target value is always used with the Close tolerance value. When picking up labware, the grippers close until the Grip torque (set in the Labware Editor) is reached. Then, the robot checks to see if the distance between the grippers is within the Close target value +/- the Close tolerance value. If it is outside the summed value, the software will display an error message.
Close tolerance	The distance, in millimeters, the Close target is allowed to vary without causing an error. The default value is +/-3 mm.

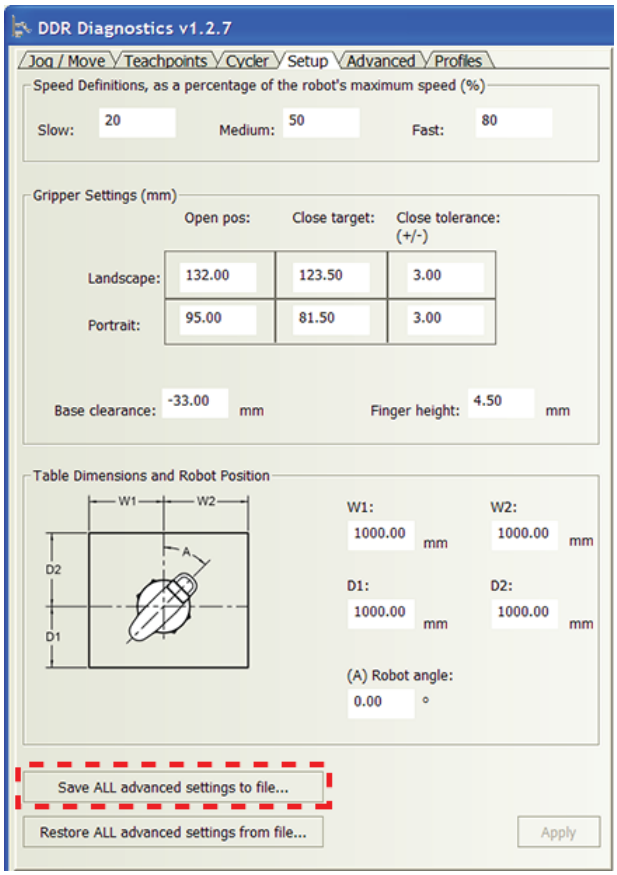
The default gripper settings should work for labware that meet the American National Standards Institute (ANSI) standards. However, you can fine-tune the settings to accommodate different labware materials, such as soft PCR microplates.

Backing up existing settings

Agilent Technologies recommends that you back up the existing gripper settings before changing them.

To back up existing settings:

1 In the **DDR Diagnostics Setup** tab, click **Save ALL advanced settings to file.**



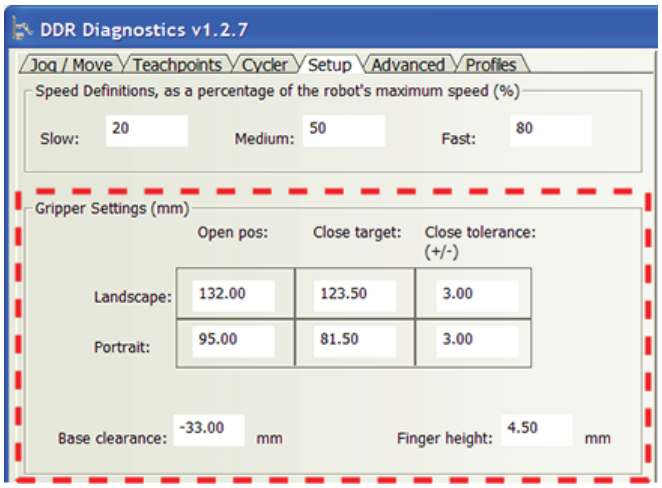
2 In the Save As dialog box that appears, type a name for the backup file. You can use the default backup file location, or select a different location. The default location is C:\Program Files\Agilent Technologies\Settings\DDR\FirmwareBackup.

3 Click **Save.** The robot settings are saved in an XML file.

Specifying new settings

To change the gripper settings:

1 In **DDR Diagnostics**, click the **Setup** tab.

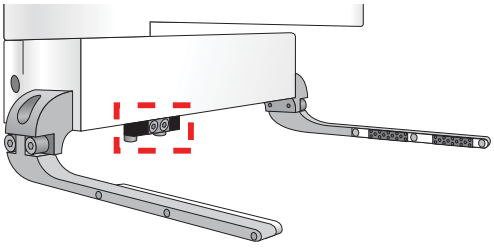


2 In the **Gripper Settings** area, type the new values you want to use for **Open pos**, **Close target**, and **Close tolerance.**

3 When you are finished, click **Apply.** The changes are saved to the firmware.

Checking the Direct Drive Robot microplate sensor

The microplate sensor under the robot hand is used to detect the presence of labware in its grip. If you suspect that the microplate sensor is not working correctly, you can check to see if it requires recalibration.



To check the microplate sensor:

1 Move the robot to a teachpoint that has a labware.

2 Move the robot up so that it is at the correct robot gripper offset for the labware.

3 Close the gripper.

4 Move the robot away from the teachpoint. The microplate sensor is highly sensitive and might detect the plate stage or platepad as labware. Moving the robot away from any teachpoint would provide the most accurate detection result.

5 In the **Robot Status** area, check the **Plate sensor** indicator.

If the indicator light is on, the microplate sensor is detecting a labware in its grippers.

If the indicator light is off, the microplate sensor is not detecting labware. Contact Automation Solutions Technical Support to see if the sensor needs to be recalibrated.

6 Open the gripper to release the labware.

Changing the Direct Drive Robot display

In the Robot Status area, a graphical representation of the Direct Drive Robot shows the robot posture, teachpoints, and the system table. You can change the view using the buttons above the image.

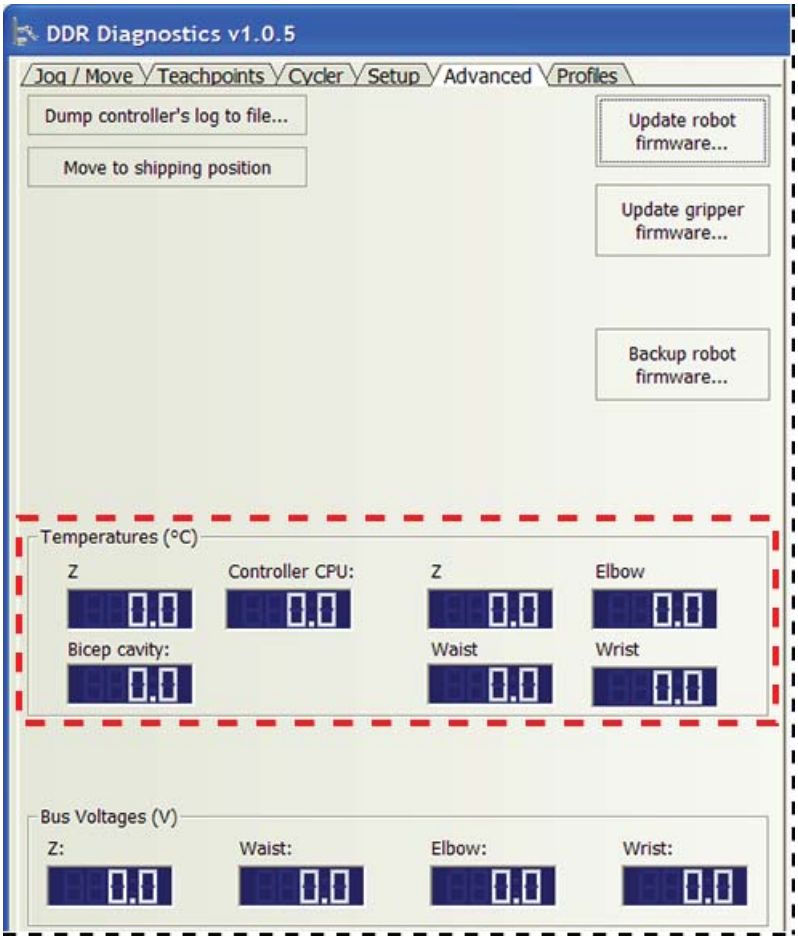
Button	Description
	Pans, or moves the image. Click the button, and then drag the image in the desired direction.
	Rotates the image. Click the button, and then drag the image to rotate it in the desired direction. Alternatively, click the middle mouse button or wheel, and then drag the image to rotate it.
	Increases or reduces the image magnification. Click the button, and then drag the image upward or downward to increase or decrease the magnification respectively. Alternatively, scroll the mouse wheel to change the magnification.
	Resets the image to the default view.
	Saves the current view as the default view.

Checking the temperature and bus voltage

The robot temperature and bus voltage can be useful for troubleshooting problems. This topic explains where you can find the temperature and bus voltage information.

Checking the temperature

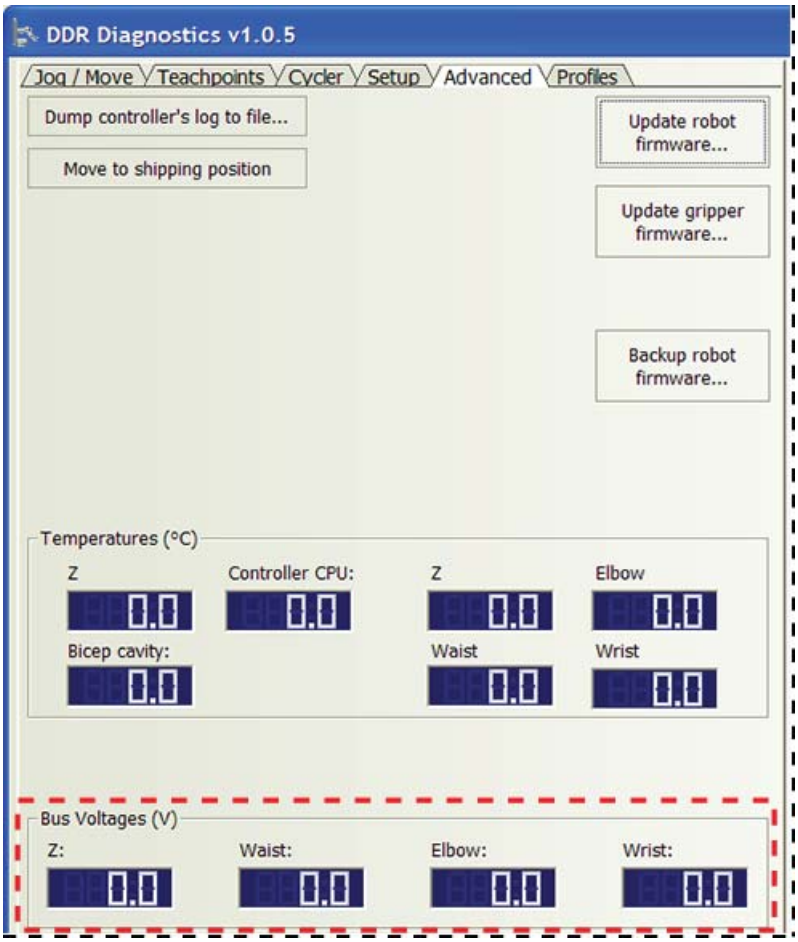
Sensors inside the robot monitor the temperature of different components. The temperatures are displayed in the **Advanced** tab, and the values are updated every 2 seconds.



If the any of the temperatures rise above the factory-set threshold value, the robot will shut down and display an error. If this happens, contact Automation Solutions Technical Support.

Checking the bus voltage

Voltages delivered to robot motors are displayed in the **Advanced** tab. The values are updated every 2 seconds.



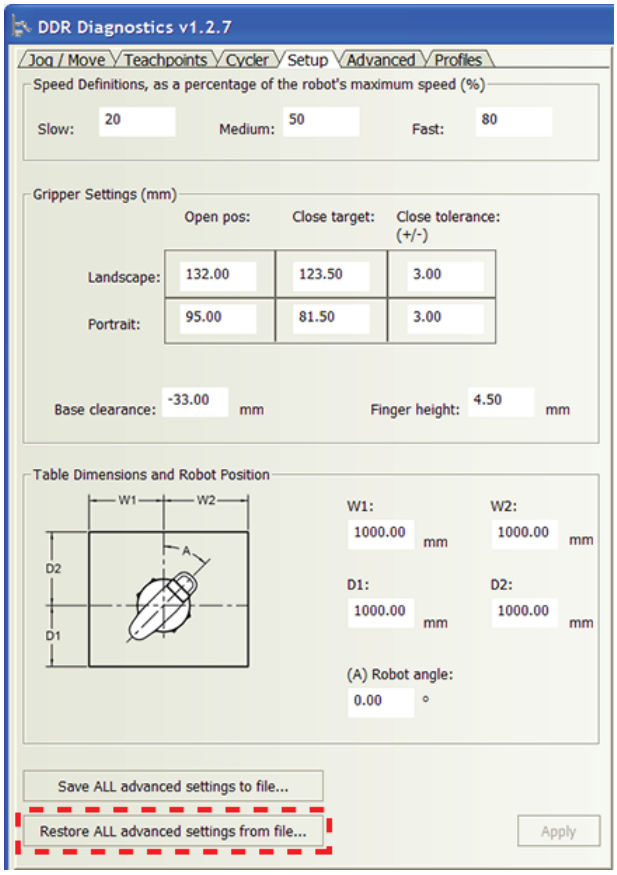
The voltage values can be used to troubleshoot problems. For example, the bus voltage values are reduced signficantly when the motors are disabled. If this happens and you did not disable the motors, contact Automation Solutions Technical Support.

Restoring the robot settings

In the Setup tab, when you click the Save ALL advanced settings to file, the software saves all of the values that are in the Setup tab to an XML file, also called a configuration file. If any of the settings were lost, you can recover them using the XML file.

To restore the robot settings:

1 In the **Setup** tab, click **Restore All advanced settings from file.**



2 In the **Open** dialog box, locate and select the desired configuration file.

3 Click **Open.** The settings are restored.

Updating the firmware

The Direct Drive Robot is controlled by the following:

- *Robot firmware*. Controls the robot arm.
- *Gripper firmware*. Controls the robot grippers only.

This section explains how to check the firmware versions you are using and update both firmware.

Agilent Technologies recommends that only administrators and trained personnel use the procedures in this topic to update the BioCel System firmware.

CAUTION The procedures in this topic is for BioCel 900 robot firmware version 1.2.0 or later. For robot firmware version 1.1.x or earlier, contact Automation Solutions Technical Support before updating the firmware.

Firmware compatibility

Agilent Technologies will release compatible robot and gripper firmware together, so you should always update both the robot firmware and the gripper firmware at the same time. Failure to do so will cause an error message during initialization.

Before you start

Before you start to update the existing firmware:

- Save the existing robot settings. In the **Setup** tab, click **Save ALL advanced settings to file.**
- Make sure you have the correct files for the update process:
  - *DDR**FirmwareUpdate**_x_x_x-.zip*. Updates the existing robot firmware and retains the existing robot settings, such as robot table dimensions.
  - *DDR**Gripper**x.x.sw*. Installs the new gripper firmware.

Note: At the beginning of the update process, the software will automatically back up the current robot firmware. You do not need to manually back up the firmware.

Checking the firmware versions you are running

To check the firmware versions you are currently running:

In **DDR Diagnostics**, click the **About** button at the bottom of the dialog box. The About DDR Plugin dialog box appears and displays the robot and gripper firmware version numbers. Note the firmware version numbers.

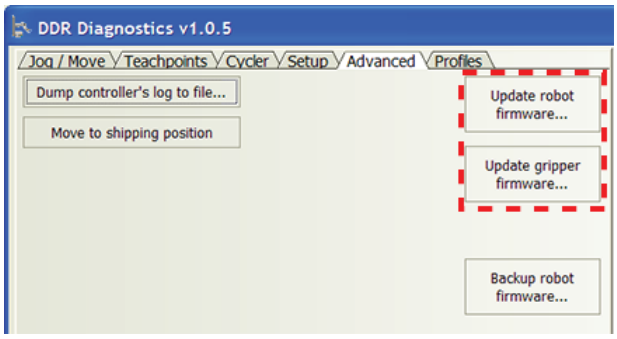
CAUTION If you have BioCel 900 robot firmware version 1.1.x or earlier, contact Automation Solutions Technical Support before updating the firmware.

Updating the robot and gripper firmware

To upgrade the robot and gripper firmware:

1 In the **Advanced** tab, click one of the following:

- **Update robot firmware**
- **Update gripper firmware**



2 In the **Open** dialog box that appears, locate and select the desired firmware file:

- DDRFirmwareUpdate_x_x_x-.zip (if you are updating the robot firmware)
- DDR_Gripperx.x.sw (if you are updating the gripper firmware)

IMPORTANT *Robot firmware update only*. If you select a file that does not have the DDRFirmware character string in the name, the update procedure will fail.

3 Click **Open.** Follow the instructions on the screen to install the firmware.

Backing up the robot firmware

You should back up the robot firmware in case it becomes damaged. The backup process backs up the robot firmware only. It does not back up the gripper firmware.

This topic explains how to back up the existing robot firmware.

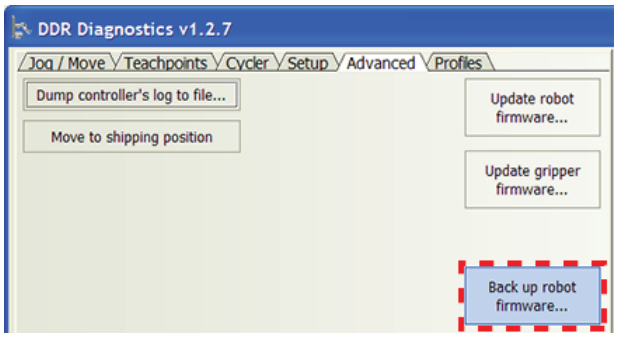
Agilent Technologies recommends that only administrators and trained personnel use the procedures in this topic to back up the BioCel System firmware.

To back up the existing firmware

1 In the **DDR Diagnostics Profiles** tab, make sure the correct profile is selected, and then click **Initialize this profile.**

IMPORTANT Communication must be established with the robot for the backup procedure to be successful.

2 In the **DDR Diagnostics Advanced** tab, click **Backup firmware.**



3 In the Save As dialog box that opens:

a Type a name for the backup file.

IMPORTANT The file name must contain the character string DDRFirmware. The software uses the string to identify the file during firmware updates. For example, a valid name is DDRFirmwareBackup_20100310_112905.zip.

b Use the default backup file location, or select a different location. The default location is C:\Program Files\Agilent Technologies\Settings\DDR\Firmware Backup.

4 Click **Save.** The robot firmware is saved in a ZIP file.

Restoring existing firmware

In case the firmware files become damaged and the robot no longer operates, you can use a backup copy of the firmware to restore robot operation.

This topic explains how to use firmware backup files to restore robot operation.

Agilent Technologies recommends that only administrators and trained personnel use the procedures in this topic to restore the BioCel System firmware.

CAUTION Use the instructions in this topic only if you have determined the firmware files are damaged. If you are not sure, contact Automation Solutions Technical Support for assistance.

CAUTION Do not use this procedure to update firmware. The restoration procedure will install the backup firmware and erase existing robot settings.

CAUTION The procedure in this topic is for BioCel 900 robot firmware version 1.2.0 or later. For robot firmware version 1.1.x or earlier, contact Automation Solutions Technical Support.

Before you start

Make sure you have the correct files for the procedure:

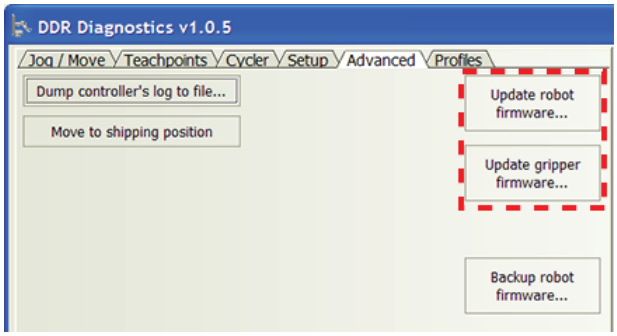
- *DDRFirmware**Backup**_<date>.zip*. The backup copy of the existing robot firmware.
- *DDR**Gripper**x.x.sw*. The gripper firmware file that accompanies the robot firmware update file from Agilent Technologies.
- <filename>.xml. The XML file that contains the robot settings, such as robot table dimensions, gripper settings, and so on. This file is created when you click **Save ALL advanced settings to file** in the **Setup** tab.

Installing the robot and gripper firmware

To restore or install the robot and gripper firmware:

1 In the **Advanced** tab, click one of the following:

- **Update robot firmware**
- **Update gripper firmware**



2 In the **Open** dialog box that appears, locate and select the desired firmware file:

- DDRFirmwareBackup_<date>.zip (if you are restoring the robot firmware using a backup copy)
- DDR_Gripperx.x.sw (if you are installing the gripper firmware)

IMPORTANT *Robot firmware update only.* If you select a file that does not have the DDRFirmware character string in the name, the procedure will fail.

3 Click **Open.** Follow the instructions on the screen to install the firmware.

4 To restore the robot settings, in the **Settings** tab, click **Restore ALL advanced settings from file.**

Viewing the DDR Diagnostics log area

The log area at the bottom of the dialog box shows the status of the commands or actions issued while you are working in the dialog box.

03/01/10 19:24:28- Successfully opened a connection to DDR.
03/01/10 19:24:50- Command begin: Initialize
03/01/10 19:24:51- Command complete
03/01/10 19:24:51- Successfully opened a connection to DDR profile 2.

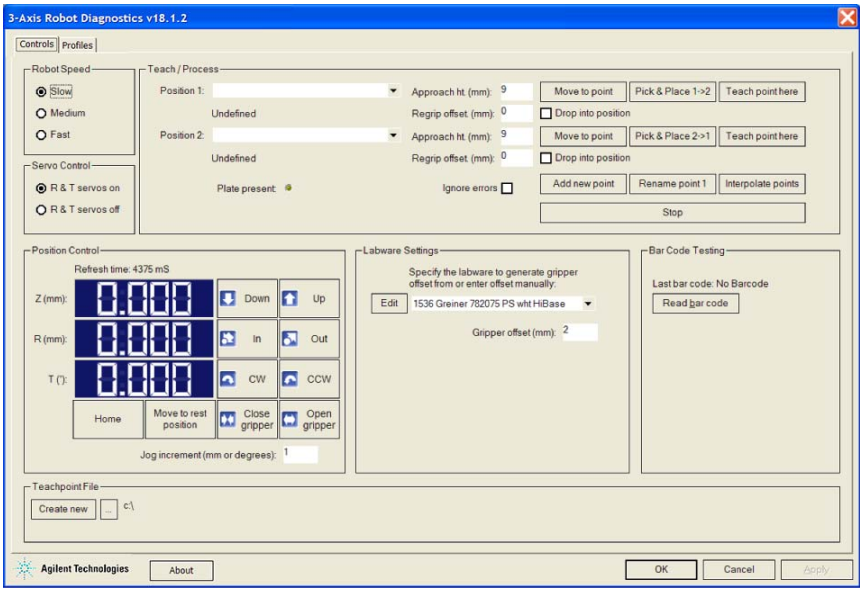
Related information

For information about...	See...
Direct Drive Robot description	"Direct Drive Robot" on page 15
Setting up the Direct Drive Robot	"Setting up the Direct Drive Robot" on page 45

3-Axis Robot Diagnostics

About 3-Axis Robot Diagnostics

The 3-Axis Robot Diagnostics software allows you to control the motions of the 3-Axis Robot. The software has two tabs: Diagnostics and Profiles. You use the command and parameters available in the Diagnostics tab when troubleshooting problems.



This topic explains the following:

- “Homing the 3-Axis Robot” on page 230
- “Resting the 3-Axis Robot” on page 230
- “Disabling and enabling the 3-Axis Robot motors” on page 231
- “Changing the 3-Axis Robot speed” on page 231
- “Jogging the 3-Axis Robot” on page 232
- “Opening and closing the 3-Axis Robot grippers” on page 233
- “Checking the 3-Axis Robot plate sensor” on page 234
- “Scanning a barcode label” on page 235
- “Ignoring 3-Axis Robot errors” on page 235
- “Checking communication time” on page 236

See “Quick reference” on page 355 for the complete list of available commands you can use.

For instructions on setting and verifying teachpoints, see “Setting 3-Axis Robot teachpoints” on page 117.

For information about using the Profiles tab, see “Creating and managing 3-Axis Robot profiles” on page 113 and “Quick reference” on page 355.

Homing the 3-Axis Robot

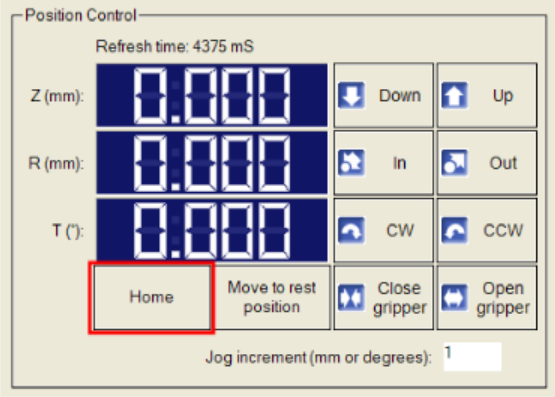
Homing the robot sends the robot to the factory-defined home position for each of the three axes of motion. The homing process recalibrates the robot position along each axis so that the home *z*, *r*, and *t* coordinates are 0, 0, 0.

Home the robot if you notice that the robot is not accurately picking up or placing labware. You might also want to home the robot after recovering from an emergency stop or after the robot collides with an obstacle.

Note: The robot homes automatically each time you start the VWorks software.

To home the robot:

In the **Controls** tab **Position Control** area, click **Home.**



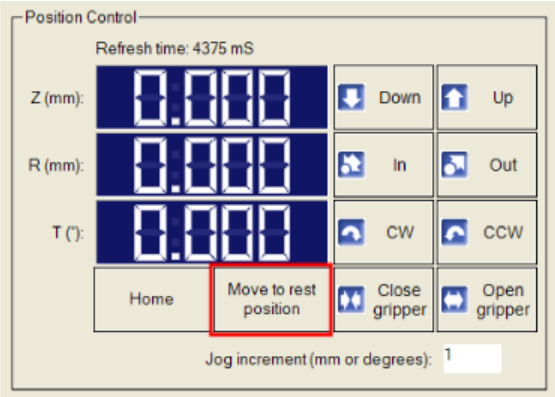
Resting the 3-Axis Robot

Resting the robot sends the robot directly to the factory-defined home position without recalibrating each axis of motion. Therefore, resting the robot is faster than homing the robot.

Use the command when you want to move the robot to the home position quickly without recalibration.

To rest the robot:

In the **Controls** tab **Position Control** area, click **Move to rest position.**



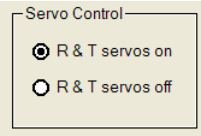
Disabling and enabling the 3-Axis Robot motors

Disabling the robot motors allows you to move the robot by hand, making it easier to set and edit teachpoints.

Note: You can disable the robot *r*-axis and *t*-axis motors. You cannot disable the *z*-axis motor. Therefore, you can move the robot by hand in the plane of the robot arm, but you cannot change its height.

To disable or enable the robot motors:

In the **Controls** tab **Servo Control** area, click one of the following:



Selection	Description
R & T servos on	Turns on the *r*-axis and *t*-axis motors.
R & T servos off	Turns off the *r*-axis and *t*-axis motors.

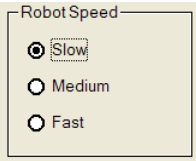
For the description of the axes, see "Jogging the 3-Axis Robot" on page 232.

Changing the 3-Axis Robot speed

You can select the robot speed to accommodate the task you are performing. For example, you can select the Slow speed when you are creating new teachpoints, creating and testing protocols, or diagnosing problems with the system. When you are ready to run a protocol that you have tested, you can select the Fast speed.

To select the robot speed:

In the **Controls** tab **Robot Speed** area, select one of the following: **Fast, Medium,** or **Slow.**



The speed you select in 3-Axis Robot Diagnostics applies only to the robot commands in Robot Diagnostics (jog direction, Move to point, Pick & Place, and so on). If the robot is holding a microplate, the slower of the following will be applied: the speed you selected in the Labware Editor or the speed you selected in 3-Axis Robot Diagnostics.

Note: During a protocol run, the robot will use the speed selection in the VWorks software Tools > Options dialog box. If the robot is holding a microplate, the slower of the following will be applied: the speed in the Labware Editor or the speed in the Tools > Options dialog box. For more information, see the *VWorks Automation Control User Guide*.

Jogging the 3-Axis Robot

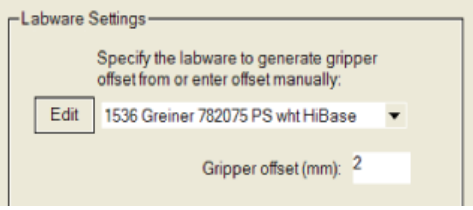
Jogging the robot moves the robot and robot grippers in small, precise increments along one of the axes. You can jog the robot to fine-tune its position when creating and editing teachpoints or during troubleshooting.

To jog the robot:

1 In the **Controls** tab, enable the robot motors. See "Disabling and enabling the 3-Axis Robot motors" on page 231.

2 If you intend to pick up a labware, specify the gripper offset, the height at which the robot should grip the labware (usually 2–3 mm above the teachpoint height). To do this, in the **Labware Settings** area, either:

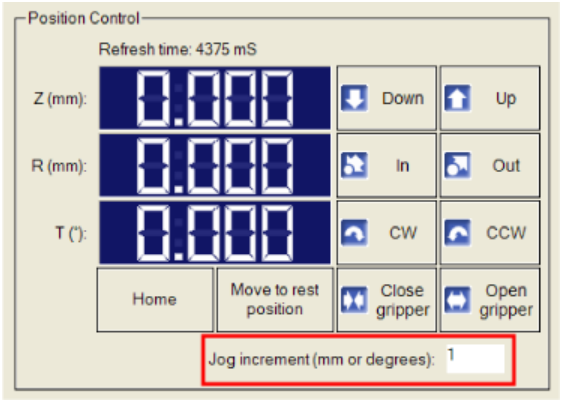
- Select a labware from the list. The offset value for that labware appears in the **Gripper offset** box.
- Enter a temporary value directly in the **Gripper offset** box. The temporary value is used only during the current diagnostic session. To save the new value for the labware, use the Labware Editor. For instructions, see the *VWorks Automation Control Setup Guide*.


Labware Settings
Specify the labware to generate gripper offset from or enter offset manually:
Edit
1536 Greiner 782075 PS wht HiBase
Gripper offset (mm):
2

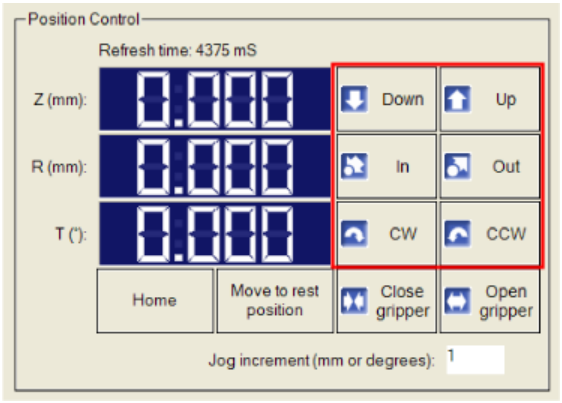
3 To set or change the jog increment, in the **Jog increment (mm or degrees)** box, type the increment value you want to use.

CAUTION Always select smaller jog increments so that the robot does not bump into obstacles in its path.

IMPORTANT The jog increment applies to all jog directions.



4 In the **Position Controls** area, click one of the following jog direction buttons. The display to the left of the jog direction buttons shows the current coordinates of the robot relative to the home position.



Command	Description
Down	Jogs the robot down by the specified increment.
Up	Jogs the robot up by the specified increment.
In	Jogs the robot inward by the specified increment.
Out	Jogs the robot outward by the specified increment.
CW	Jogs the robot clockwise by the specified increment.
CCW	Jogs the robot counterclockwise by the specified increment.

Opening and closing the 3-Axis Robot grippers

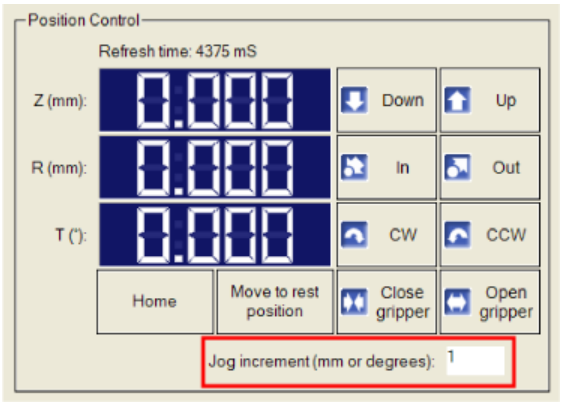
You can open the robot grippers to release labware. You can close the robot grippers to hold labware.

To open or close the robot grippers:

1 In the **Position Control** area, set or change the open or close increment. To do this, in the **Jog increment (mm or degrees)** box, type the increment value you want to use.

CAUTION Always select smaller jog increments so that the robot does not bump into labware when it opens its grip, or bend the labware when it closes its grip.

IMPORTANT The jog increment applies to both grip directions.



2 Click one of the following:

Command	Description
Close gripper	Closes the robot gripper by the specified increment.
Open gripper	Opens the robot gripper by the specified increment.

Checking the 3-Axis Robot plate sensor

The plate sensor in the robot gripper is used to detect the presence of labware in its grip. If you suspect that the plate sensor is not working correctly, you can check to see if it requires recalibration.

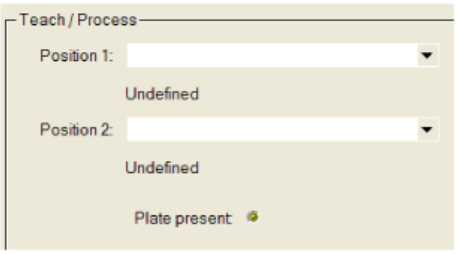
To check the plate sensor:

1 Move the robot to a teachpoint that has a labware.

2 Move the robot up so that it is at the correct robot gripper offset for the labware.

3 Close the gripper.

4 In the **Teach/Process** area, check the **Plate present** indicator.



If the indicator light is on, the plate sensor is detecting a labware in the gripper.

If the indicator light is off, the plate sensor is not detecting labware. Contact Automation Solutions Technical Support to see if the sensor needs to be recalibrated.

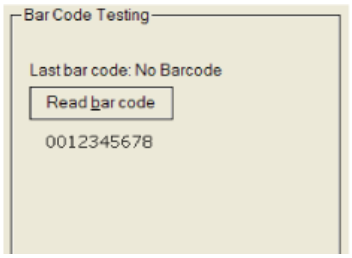
5 Open the gripper to release the labware.

Scanning a barcode label

You can verify that the barcode reader is working correctly or troubleshoot the barcode reader using the Diagnostics software.

To scan a barcode label:

1. Place the labware with the barcode label on a platepad.
2. In the **Teach/Process** area, select the teachpoint from which to pick up the labware in the **Position 1** list.
3. In the **Position 2** list, select **Nowhere**.
4. For Position 1, type a value for **Approach ht.** For the description of the parameter, see "Setting new teachpoints" on page 119.
5. Click **Pick & Place 1->2.** The robot moves to Position 1 and picks up the labware. During the pickup process, the barcode reader scans the barcode label and displays it in the Bar Code Testing area.



To scan the barcode while the robot grippers are holding the labware, in the **Bar Code Testing** area, click **Read barcode.** The barcode reader scans the barcode label and displays it in the Bar Code Testing area.

Ignoring 3-Axis Robot errors

You have the option of ignoring robot error messages when using 3-Axis Robot Diagnostics. You might want to ignore error messages, for example, when you want to simulate the movement of labware without using labware. Under normal operating conditions, the software displays a plate-sensor error if you request a labware move without picking the labware.

This setting only affects the use of 3-Axis Robot Diagnostics. It does not affect VWorks software error settings.

To ignore errors when using 3-Axis Robot Diagnostics:

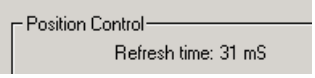
In the **Teach/Process** area, select **Ignore errors.**

Checking communication time

Robot communication time is the length of time it takes for the software to receive the positional coordinates from the robot. To ensure optimum performance, check that the communication time is shorter than 100 milliseconds. If the time is consistently longer than 100 milliseconds, contact Automation Solutions Technical Support.

To check the robot communication time:

In the **Position Control** area, check the **Refresh time.**



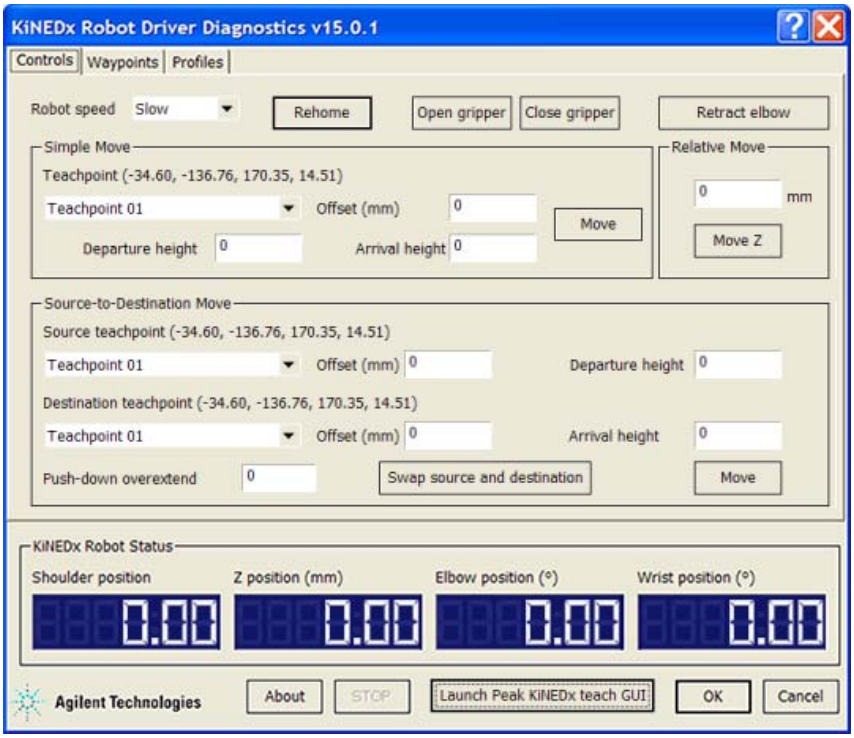
Related information

For information about...	See...
Full description of the Robot Diagnostics software	"Robot diagnostics software" on page 25
Diagnostics software error messages	"Troubleshooting error messages" on page 189
Labware Editor	*VWorks Automation Control Setup Guide*
Setting and editing teachpoints	"Editing existing 3-Axis Robot teachpoints" on page 127

KiNEDx Robot Driver Diagnostics

About KiNEDx Robot Driver Diagnostics

The KiNEDx Robot Driver Diagnostics software allows you to control the motions of the KiNEDx Robot. The software has three tabs: Controls, Waypoints, and Profiles. You use the command and parameters available in the Controls tab when troubleshooting robot-motion problems.



This topic explains the following:

- "Homing the KiNEDx Robot" on page 238
- "Changing the KiNEDx Robot speed" on page 238
- "Opening and closing KiNEDx Robot grippers" on page 239
- "Retracting the KiNEDx Robot arm" on page 239

See "Quick reference" on page 355 for the complete list of available commands you can use.

To jog the robot or to disable the robot motors, in the Controls tab, click **Launch Peak KiNEDx teach GUI.** The KiNEDx Robot Teach Pendant dialog box opens. For instructions on using the KiNEDx Robot Teach Pendant software, see the Peak KiNEDx Robot user documentation.

For instructions on setting and verifying teachpoints and waypoints, see "Setting KiNEDx Robot teachpoints" on page 135.

For information about using the Profiles tab, see "Creating and managing KiNEDx Robot profiles" on page 131 and "Quick reference" on page 355.

Homing the KiNEDx Robot

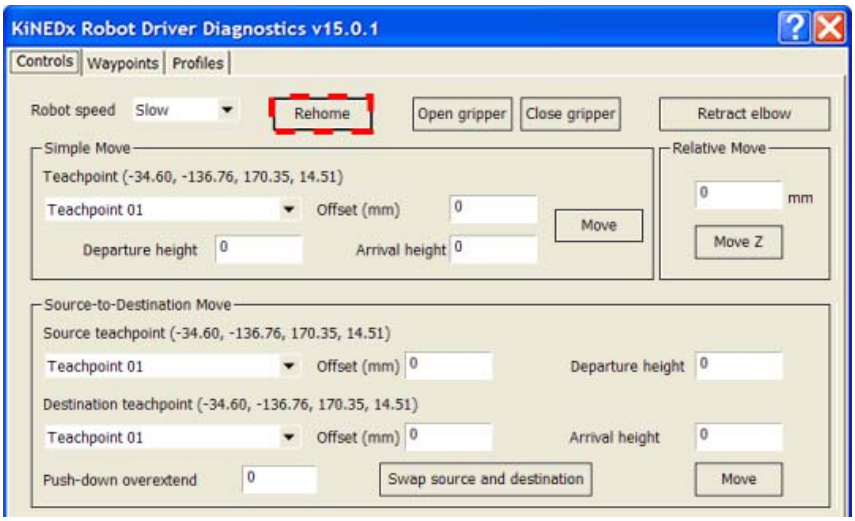
Homing the robot sends the robot to the factory-defined home position for each of the four axes of motion.

Home the robot if you notice that the robot is not accurately picking up or placing labware. You might also want to home the robot after recovering from an emergency stop.

Note: The robot homes automatically each time you start the VWorks software.

To home the robot:

In the **Controls** tab, click **Rehome.**

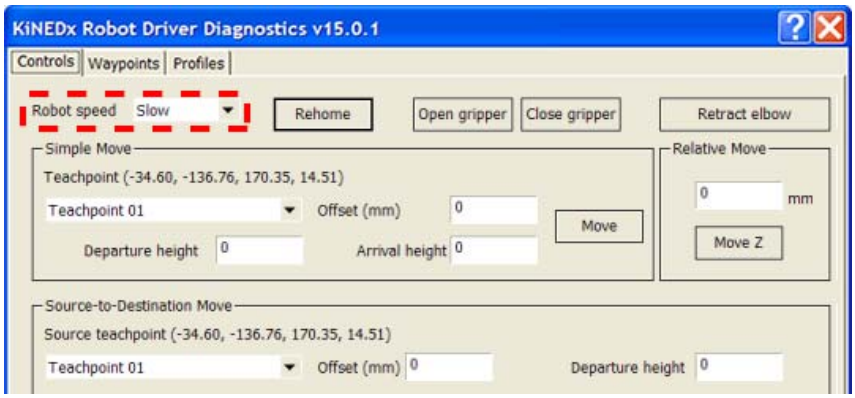


Changing the KiNEDx Robot speed

You can select the robot speed to accommodate the task you are performing. For example, you can select the Slow speed when you are creating new teachpoints, creating and testing protocols, or diagnosing problems with the system. When you are ready to run a protocol that you have tested, you can select the Medium or Fast speed.

To select the robot speed:

In the **Controls** tab, select one of the following from the **Robot speed** list: **Slow, Medium,** or **Fast.**



The speed you select in KiNEDx Robot Driver Diagnostics applies only to the robot commands in KiNEDx Robot Driver Diagnostics and KiNEDx Robot Teach Pendant. If the robot is holding a microplate, the slower of the following will be applied: the speed you selected in the Labware Editor or the speed you selected in KiNEDx Robot Driver Diagnostics.

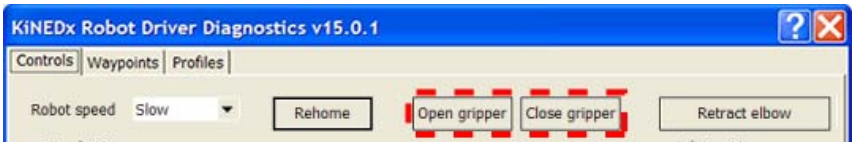
Note: During a protocol run, the robot will use the speed selection in the VWorks software Tools > Options dialog box. If the robot is holding a microplate, the slower of the following will be applied: the speed in the Labware Editor or the speed in the Tools > Options dialog box. For more information, see the *VWorks Automation Control User Guide*.

Opening and closing KiNEDx Robot grippers

You can open the robot grippers to release labware. You can close the robot grippers to hold labware.

To open or close the robot grippers:

In the **Controls** tab, click **Open gripper** or **Close gripper.**

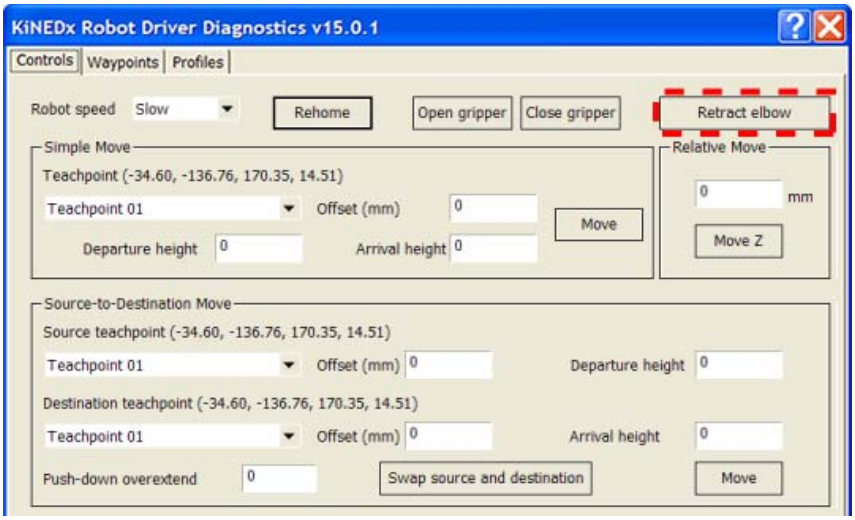


Retracting the KiNEDx Robot arm

You can retract the robot arm to ensure a minimum footprint.

To retract the robot arm:

In the **Controls** tab, click **Retract elbow.**



Related information

For information about...	See...
KiNEDx Robot Driver Diagnostics	"Robot diagnostics software" on page 25
Using the KiNEDx Robot Teach Pendant software	Peak KiNEDx Robot user documentation
Setting and editing teachpoints and waypoints	"Setting KiNEDx Robot teachpoints" on page 135

A
Additional BioCel System Devices

This chapter describes the additional devices available for integration in the BioCel System and provides installation and configuration instructions. This chapter contains the following topics:

- "BioCel System additional devices overview" on page 242
- "Auxiliary barcode reader" on page 244
- "BioCel I/O Interface" on page 251
- "Lid Hotel Station" on page 266
- "Linear Translator" on page 272
- "Microplate Conveyor" on page 285
- "Microplate Shuttle and Rotator" on page 301
- "Orbital Shaking Station" on page 309
- "Phantom Robot" on page 315
- "Plate Hotel and Plate Hub Carousel" on page 319
- "Platepad" on page 329
- "Vacuum Delid Station" on page 332
- "Waste bin" on page 337
- "Weigh Pad" on page 340

BioCel System additional devices overview

About this topic

This topic lists and briefly describes additional devices available for integration in the BioCel System. For the latest list of devices available, contact Automation Solutions Technical Support.

Additional devices list

In addition to the devices that can be integrated ("Device integration options" on page 23), you can install and configure one or more of the following Automation Solutions devices in the BioCel System.

Device	Description	See...
Auxiliary barcode reader	Scans barcodes on labware.	"Auxiliary barcode reader" on page 244
BioCel I/O Interface	Allows you to configure and manage digital and analog signals.	"BioCel I/O Interface" on page 251
Device stacking shelves	Allows the stacking of devices to maximize the use of space.	Automation Solutions Technical Support
Labware MiniHub	Stores microplates and tipboxes. The device is more compact than the Plate Hub Carousel.	*Labware MiniHub User Guide*
Labware Stacker	Stores deep-well and shallow-well microplates, pintools, tipboxes, and lids. Dispenses and receives the labware from robots.	*Labware Stacker User Guide*
Lid Hotel Station	Removes and stores microplate lids.	"Lid Hotel Station" on page 266
Linear Translator	Transports microplates, one at a time, from a device (or robot) to a device (or robot). The device has a fixed-length body with a motorized plate stage that moves from one end to another.	"Linear Translator" on page 272
Microplate Conveyor	Transports microplates, one at a time, from a device (or robot) to a device (or robot) on conveyor rollers. The device comes in different lengths to accommodate different system requirements.	"Microplate Conveyor" on page 285
Microplate Exchanger	Passes microplates between two system robots.	*Microplate Exchanger User Guide*
Microplate Shuttle and Rotator	Passes microplates between two system robots, or rotates a microplate 180° to change its orientation.	"Microplate Shuttle and Rotator" on page 301
Orbital Shaking Station	Shakes labware for a specified length of time.	"Orbital Shaking Station" on page 309

Device	Description	See...
Phantom Robot	Permits the manual movement of labware during a protocol run.	"Phantom Robot" on page 315
Plate Hotel	Stores microplates.	"Plate Hotel and Plate Hub Carousel" on page 319
Plate Hub Carousel, Landscape or Portrait	Stores microplates and tipboxes.	"Plate Hotel and Plate Hub Carousel" on page 319
Platepad	Holds a single microplate.	"Platepad" on page 329
Vacuum Delid Station	Removes microplate or tipbox lids using vacuum.	"Vacuum Delid Station" on page 332
Waste bin	Receives microplate lids, used pipette tips, or other trash.	"Waste bin" on page 337
Weigh Pad	Monitors and maintains the percentage of liquid in a container that is on the Weigh Pad.	"Weigh Pad" on page 340

Related information

For information about...	See...
Using the device in a protocol	*VWorks Automation Control User Guide*
BioCel System setup workflow	"Setup Workflow" on page 28

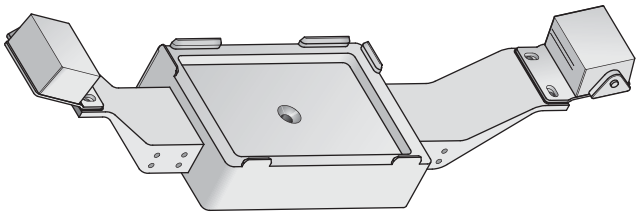
Auxiliary barcode reader

About this topic

This topic describes the auxiliary barcode reader, explains its use, and provides the setup instructions.

Description

The auxiliary barcode reader is either attached to a platepad or a device. Depending on the setup, the barcode reader scans barcodes on one of four sides of microplates. The following diagram shows an example barcode reader that is attached to a platepad and is oriented to scan barcodes on the east and west sides of microplates.



Setup workflow

Step	Procedure	See...
1	Install the barcode reader.	Automation Solutions Technical Support
2	Add the barcode reader in the device file.	"Adding the barcode reader in the device file" on page 245
3	Add the platepad or device to which the barcode reader is attached.	"Adding the platepad or device" on page 245
4	Create a profile for the barcode reader.	"Creating a profile for the barcode reader" on page 247
5	Set and edit the teachpoint for the barcode reader platepad or device.	One of the following: • "Setting Direct Drive Robot teachpoints" on page 69 • "Setting 3-Axis Robot teachpoints" on page 117 • "Setting KiNEDx Robot teachpoints" on page 135
6	Test the barcode reader.	"Testing the barcode reader" on page 248

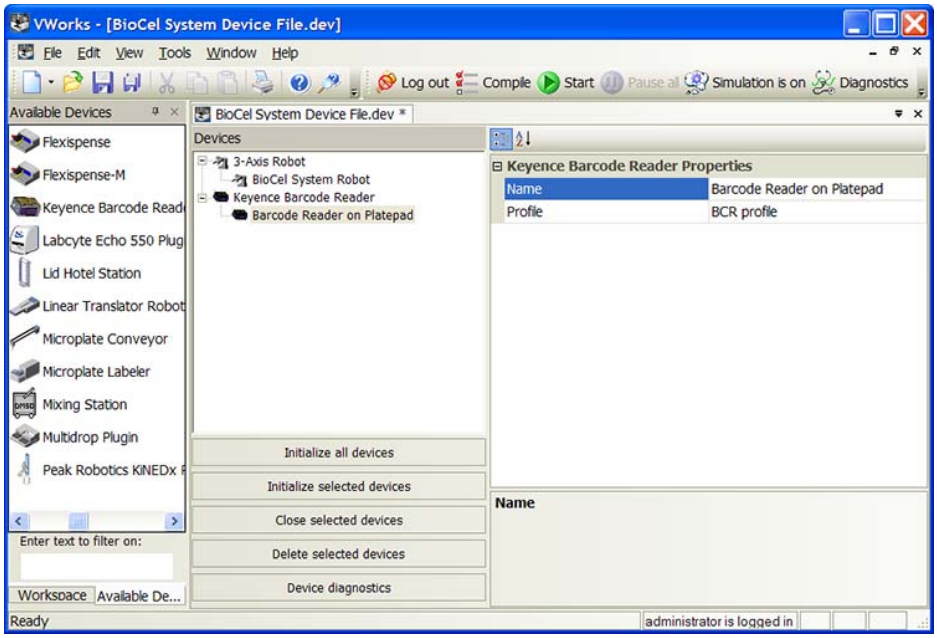
Adding the barcode reader in the device file

The VWorks software is set up with the correct device configuration to communicate with the barcode reader. You do not need to add a new barcode reader to the device file unless you want to use a different teachpoint file. For information about device files, see "Devices and device file defined" on page 39.

To add the barcode reader to the device file:

1 In the VWorks software, open the device file and add the Keyence Barcode Reader. See "Adding and deleting devices in the software" on page 39 for instructions.

2 In the **Keyence Barcode Reader Properties** area, type or select the following:



Property	Description
Name	The name of the barcode reader device.
Profile	The profile associated with the device. Select the desired profile from the list. If you have not created a profile, see "Creating a profile for the barcode reader" on page 247, and then return to this step to select the profile.

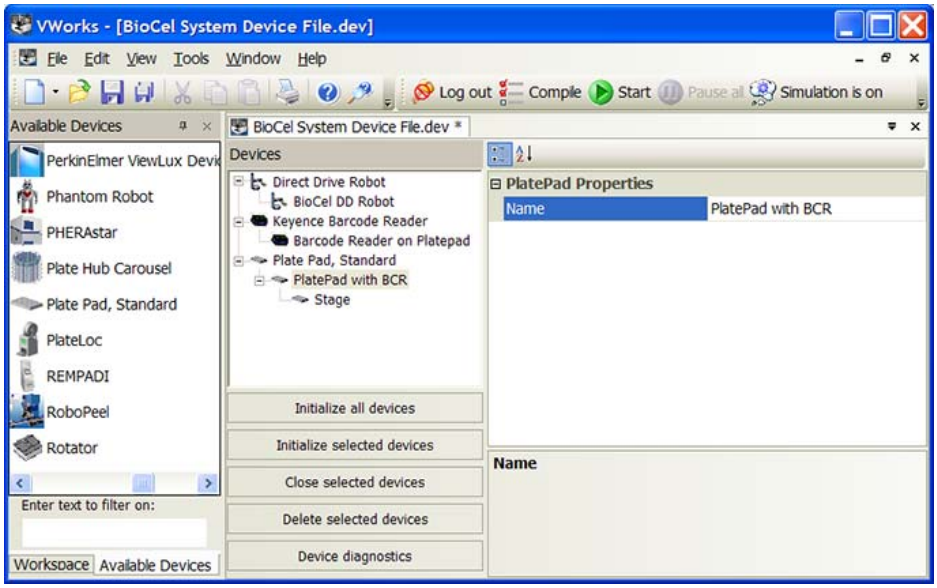
3 Select **File > Save.**

Adding the platepad or device

After adding the barcode reader in the device file, you must add the platepad or device to which the barcode reader is attached. In addition, you specify the barcode reader in the platepad or device properties.

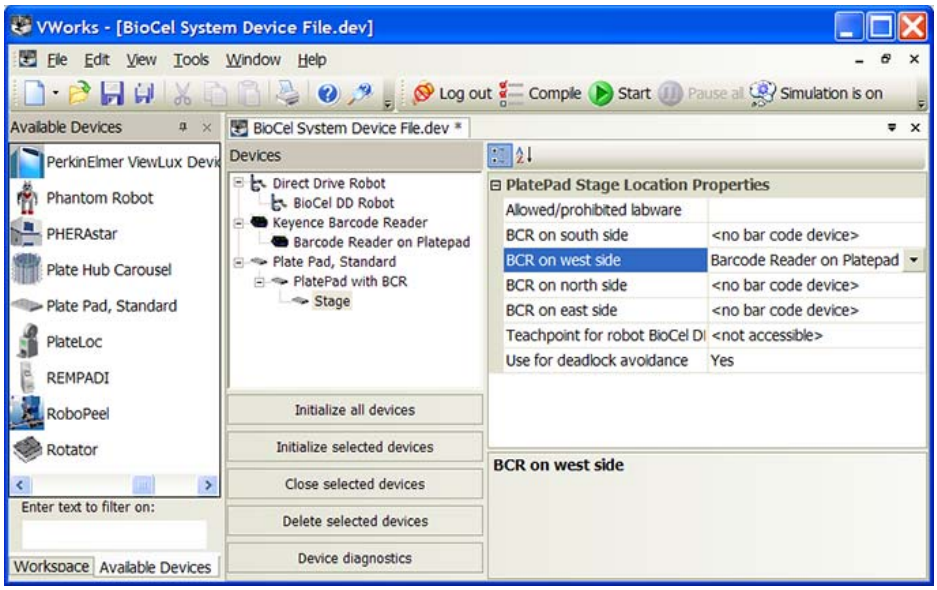
To add the platepad or device in the device file:

1 In the device file, add the Plate Pad or the desired device. See "Platepad" on page 329 or "Adding and deleting devices in the software" on page 39 for instructions.



2 In the **Devices** area, expand the **Plate Pad** or device, and then select the **Stage** to which the barcode reader is attached.

3 In the **PlatePad Stage Location Properties** or device stage properties area, type or set the parameters. See "Platepad" on page 329 or the device guide for detailed instructions. Make sure you specify the location of the barcode reader on the platepad or device.



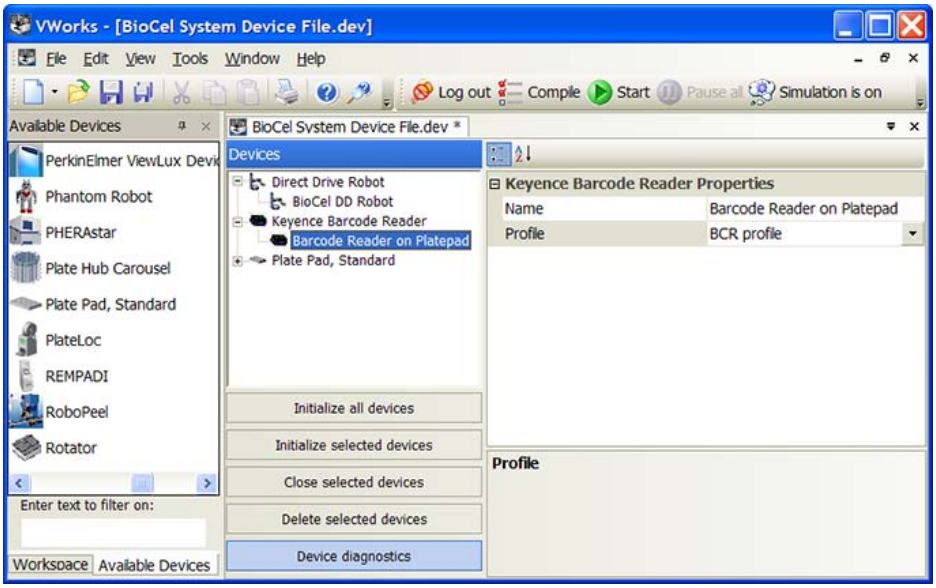
4 Select **File > Save.**

Creating a profile for the barcode reader

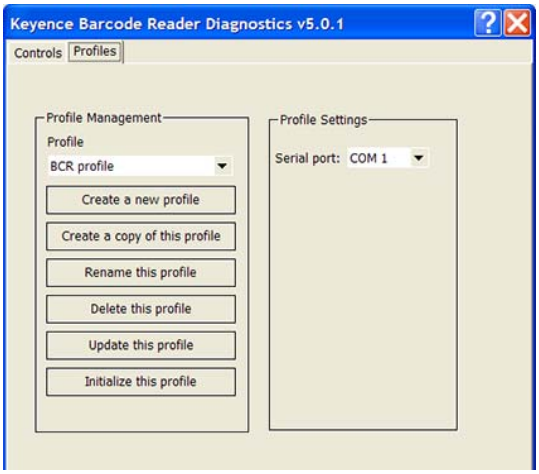
The barcode reader profile allows you to set up communication between the barcode reader and the controlling computer.

To create a profile for the barcode reader:

1 In the **VWorks** window, select the **Keyence Barcode Reader** device, and then click **Device diagnostics.**



The Keyence Barcode Reader Diagnostics dialog box opens.



2 Click the **Profiles** tab.

3 Click **Create a new profile.** The Create Profile dialog box opens.

4 Type a name for the new profile, and then click **OK.** The new profile name appears in the Profile Management area.

5 In the **Profile Settings** area, select the COM port number used by the barcode reader.

6 Click **Update this profile** to save the changes.

7 Click **Initialize this profile** to establish communication with the barcode reader.

8 Return to the device file and select the profile for the barcode reader device.

Testing the barcode reader

Barcode label specifications

The barcodes must meet the following requirements:

Characteristic	Requirement
Barcode formats	Code 39 Codabar Code 128 Interleaved 2 of 5 Code 93 UPC/EAN Pharmacode PDF417
Barcode height	3.34 mm (0.13 in) or taller
Print contrast	25% at 650 nm
Quiet zone	10 times the dimension of the narrowest element in the barcode or 6.35 mm (0.25 in), whichever is greater

Before you start

Make sure you have the following:

- M2 hex wrench
- Spare microplate that has a barcode label

Test procedure

WARNING The barcode reader sensor head contains a class II laser that emits light at 650 nm, producing up to 1.5 mW of energy. Do not look directly into the laser beam. Looking directly into the laser beam or looking at the reflected beam can cause eye injury.

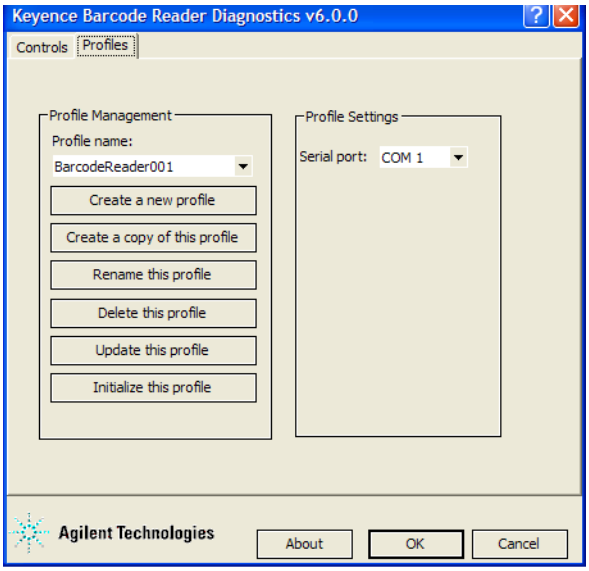
WARNING Do not disassemble the barcode reader sensor head. Laser emission does not automatically turn off if the sensor head is disassembled.

To test the barcode reader:

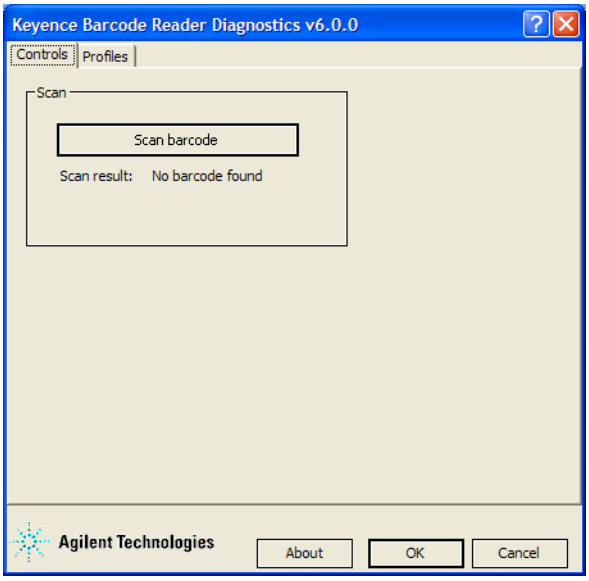
1 Place the spare microplate on the Barcode Reader location and make sure the barcode label faces the Barcode Reader mirror.

2 Open **Keyence Barcode Reader Diagnostics.**

3 In the **Profiles** tab, select the Barcode Reader profile from the **Profile** list, and click **Initialize this profile**.



4 Click the **Controls** tab.



5 Click **Scan barcode.** The barcode reader laser turns on briefly to scan the barcode label. One of the following messages appears next to Scan result:

Scan result message	Description	Next step
<barcode text>	The barcode was successfully scanned.	The setup is complete. No further adjustment is required.
No barcode found	Barcode scanning was not successful.	Proceed to step 6.

6 If the No barcode found message appears, click **Scan barcode** again and check that the barcode reader laser beam is projected onto the vertical center of the barcode label.

If the laser beam is not at the vertical center of the label, adjust the scan angle of the barcode reader.

Adjusting the scan angle

Depending on the setup, the angle adjustment process can differ. If the barcode reader is attached to a platepad, you can loosen the screws on both sides of the reader to change the scan angle. If the barcode reader is mounted on the side of a device, you might have to loosen the screws on the mounting plate to change the scan angle. If you need assistance with the process, contact Automation Solutions Technical Support.

Troubleshooting

If the reader is unable to scan the barcode after many adjustments, try one or more of the following:

- Make sure the barcode label is applied properly onto the microplate.
- Make sure the microplate is sitting level at the Barcode Reader location.
- Make sure the barcode and label meet the format requirements. See "Barcode label specifications" on page 248.
- Repeat the adjustment process using a new spare microplate.

Related information

For information about...	See...
Set the teachpoint for the barcode reader platepad or device	One of the following: • "Setting Direct Drive Robot teachpoints" on page 69 • "Setting 3-Axis Robot teachpoints" on page 117 • "Setting KiNEDx Robot teachpoints" on page 135
Using the barcode reader in a protocol	*VWorks Automation Control User Guide*
Available devices	"BioCel System additional devices overview" on page 242

BioCel I/O Interface

About this topic

This topic describes the BioCel I/O Interface, explains its use, and provides the setup and troubleshooting instructions.

Description

The BioCel I/O Interface console, located inside the system cabinet, transmits signals from various sensors to the controlling computer. In response to the signals, the computer can turn on or off status lights, turn on or off ventilation fans, open or close doors, and change the state of other items.

In the software, you can name the signal channels so that you can reference them in a protocol and in the IO Manager. The IO Manager allows you to assign digital output signals to lights and sounds, specify when to bypass the safety interlock, and select the signals to use to automate the opening and closing of doors.

When writing a protocol, you can add tasks to turn on or turn off a light, sound, or fan. You can also add tasks to wait for certain conditions to be met before continuing to the next task. For example, you can specify that a fan be turned on while a liquid-handling task is running. You can also specify that the temperature and humidity reach a certain level before the Main Protocol starts.

Setup workflow

Step	For this task...	See...
1	Add the BioCel I/O Interface device in the device file.	"Adding the BioCel I/O Interface in the device file" on page 252
2	Create a profile for the BioCel I/O Interface v3 device.	"Creating a profile for the BioCel I/O Interface" on page 253
3	Name the signal channels.	"Assigning names to signal channels" on page 255
4	Manage digital signals for: • Lights and sound • Safety interlock • Automated doors (if applicable)	One or more of the following: • "Managing signals for lights and sound" on page 257 • "Managing signals to monitor the safety interlock status" on page 259 • "Managing signals for automated doors" on page 261

To troubleshoot the BioCel I/O Interface device, see "Troubleshooting I/O channels" on page 263.

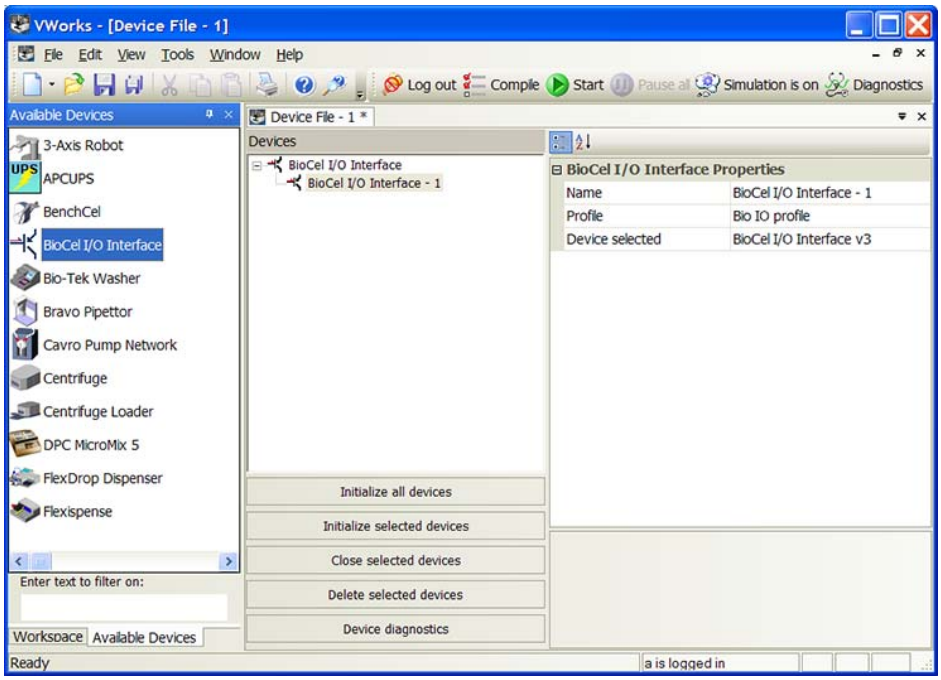
Adding the BioCel I/O Interface in the device file

The VWorks software is set up with the correct BioCel I/O Interface configuration. You do not need to add a new BioCel I/O Interface to the device file unless you want to set up additional I/O configurations. For information about device files, see "Devices and device file defined" on page 39.

To add BioCel I/O Interface to the device file:

1 In the **VWorks** window, open the device file and add the BioCel I/O Interface. See "Adding and deleting devices in the software" on page 39 for instructions.

2 In the **BioCel I/O Interface Properties** area, type or select the following:



Property	Description
Name	The name of the BioCel I/O Interface device.
Profile	The profile associated with the device. Select the desired profile from the list. If you have not created a profile, see "Creating a profile for the BioCel I/O Interface" on page 253, and then return to this step to select the profile.
Device selected	The version of BioCel I/O Interface device installed in your system. If your system was installed in 2005 or later, select BioCel I/O Interface v3. If your system was installed before 2005, select BioCel I/O Interface v2. To confirm, contact Automation Solutions Technical Support.

3 Select **File > Save.**

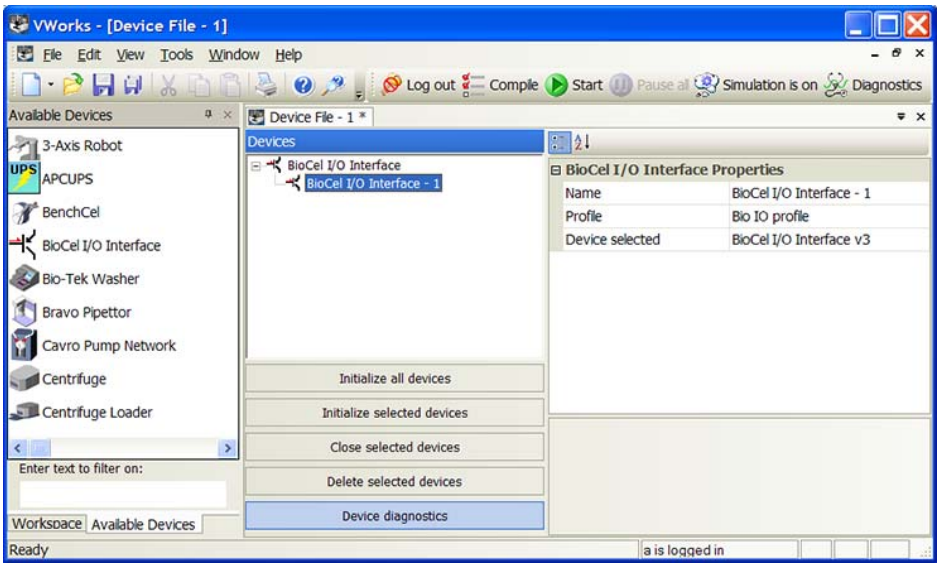
Creating a profile for the BioCel I/O Interface

The BioCel I/O Interface profile allows you to set up communication between the BioCel I/O Interface console and the controlling computer.

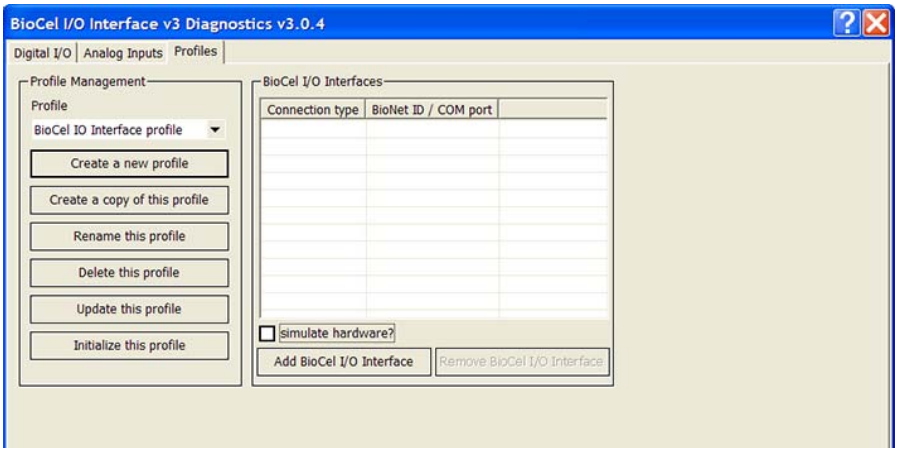
Note: You do not need to set up a profile for the BioCel I/O Interface v2 device. The procedure in this section is for systems that use the BioCel I/O Interface v3 device.

To create a profile:

1 In the **VWorks** window, select the BioCel I/O Interface device, and then click **Device diagnostics.** Alternatively, you can double-click the device icon.



The BioCel I/O Interface Diagnostics dialog box opens.

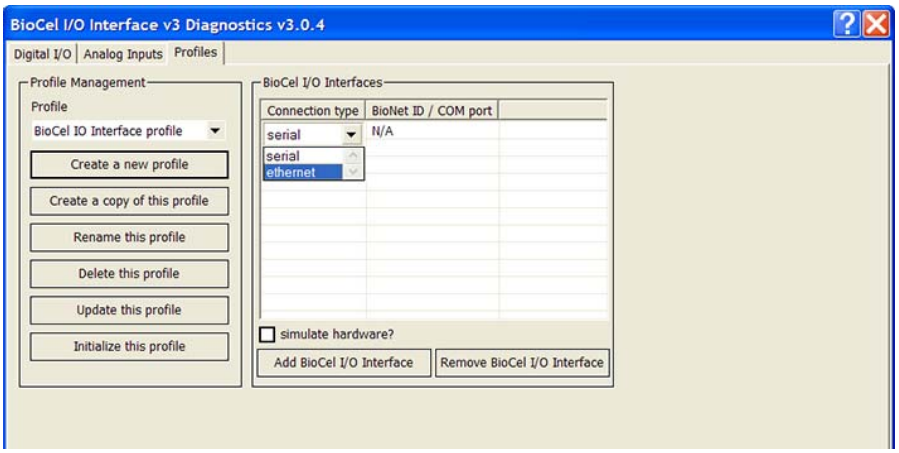


2 Click the **Profiles** tab.

3 Click **Create a new profile.** The Create Profile dialog box opens.

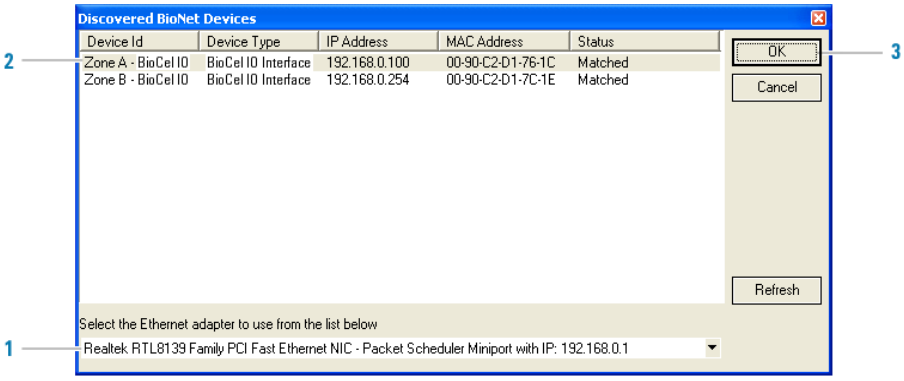
4 Type a name for the new profile, and then click **OK.** The new profile name appears in the Profile area.

5 In the **BioCel I/O Interfaces** area, click **Add BioCel I/O Interface**. A new row, serial, appears in the table. Each row represents a different I/O device.



6 Click the row and select the correct connection type: **serial** or **ethernet.** Click the **N/A** field.

7 If you selected **ethernet**, in the **Discovered BioNet Devices** dialog box that opens:



Step	Instruction
1	Select the correct Ethernet card for the device connection. A list of devices appear in the dialog box.
2	Select the BioCel I/O Interface console. You can use the MAC Address to identify the BioCel I/O Interface console in the list. To successfully communicate with the BioCel I/O Interface console, the device must show New or Matched in the Status column.
3	When you are finished, click **OK** to return to the BioCel I/O Interface Diagnostics dialog box.

8 If you selected **serial,** select the COM port number used by the BioCel I/O Interface console.

9 Click **Update this profile** to save the changes.

10 Click **Initialize this profile** to establish communication with the BioCel I/O Interface console.

11 Return to the device file and select the profile for the BioCel I/O Interface device.

Assigning names to signal channels

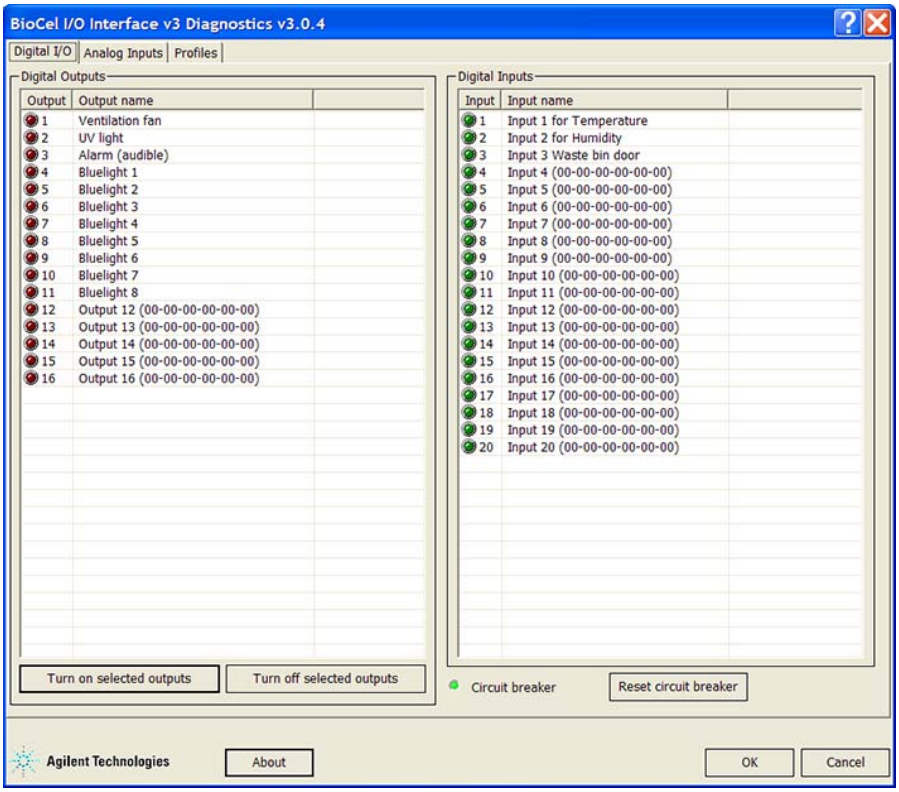
If you have the BioCel I/O Interface v3 device, you can assign names to the signal channels so that you can reference them in the protocol and in the IO Manager.

Note: The BioCel I/O Interface v2 device does not have this feature. If your system has the BioCel I/O Interface v2 device, you can skip the procedures in this section.

To assign names to the signal channels:

1 In **BioCel I/O Interface Diagnostics,** click the **Digital I/O** tab. Two lists appear. One list displays all available digital output channels, the other list displays the available digital input channels.

The following example shows the channels from one BioCel I/O Interface device. The device has 16 output channels and 20 input channels. If you added more than one BioCel I/O Interface device in the profile, additional channels would appear in these lists.



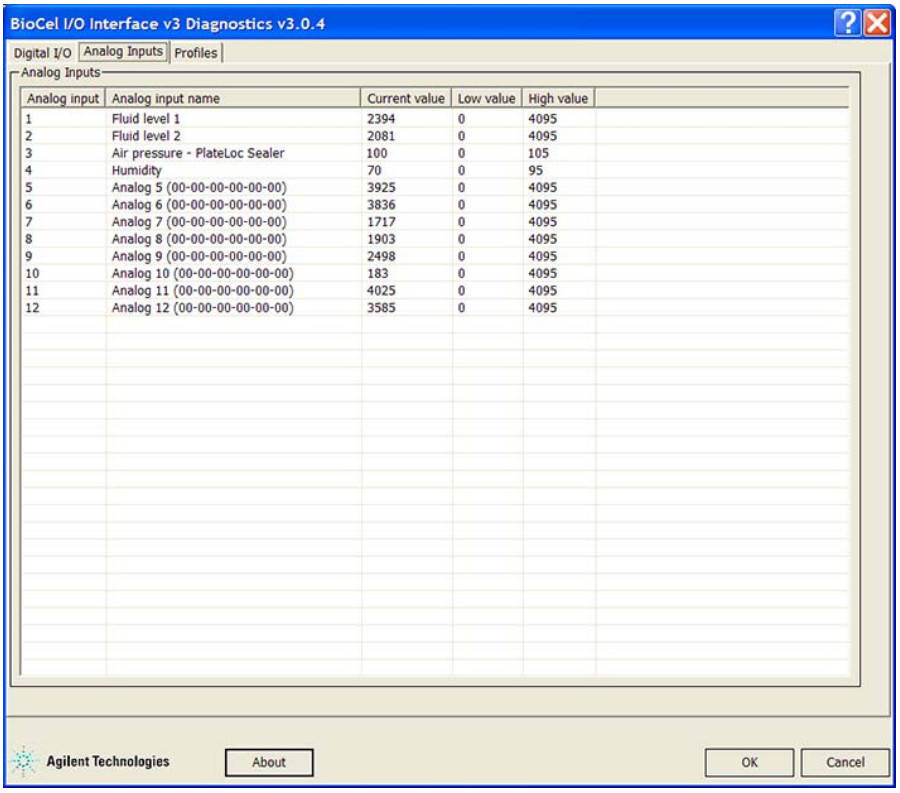
2 Double-click an output or input name field, and then type the name you want to assign to that channel.

IMPORTANT The physical wire connections at the BioCel I/O Interface console are numbered. The connection numbers must match the channel (Output or Input) numbers in the BioCel I/O Interface Diagnostics.

To verify the identity of the digital output connections, select an output, and then click **Turn on selected outputs.** The on state should help you find the correct signal channel.

3 Repeat step 2 to name all existing digital signal channels.

4 Click the **Analog Inputs** tab. A list of all the available analog input channels are shown.



Analog input	Analog input name	Current value	Low value	High value
1	Fluid level 1	2394	0	4095
2	Fluid level 2	2081	0	4095
3	Air pressure - PlateLoc Sealer	100	0	105
4	Humidity	70	0	95
5	Analog 5 (00-00-00-00-00-00)	3925	0	4095
6	Analog 6 (00-00-00-00-00-00)	3836	0	4095
7	Analog 7 (00-00-00-00-00-00)	1717	0	4095
8	Analog 8 (00-00-00-00-00-00)	1903	0	4095
9	Analog 9 (00-00-00-00-00-00)	2498	0	4095
10	Analog 10 (00-00-00-00-00-00)	183	0	4095
11	Analog 11 (00-00-00-00-00-00)	4025	0	4095
12	Analog 12 (00-00-00-00-00-00)	3585	0	4095

5 Double-click an input name field, and then type the name you want to assign to that channel.

6 When you are finished, click **OK** to save the changes and return to the **VWorks** window.

Managing digital signals

IMPORTANT Make sure you have correctly configured the BioCel I/O Interface device before setting up signals in the IO Manager.

You use the IO Manager for:

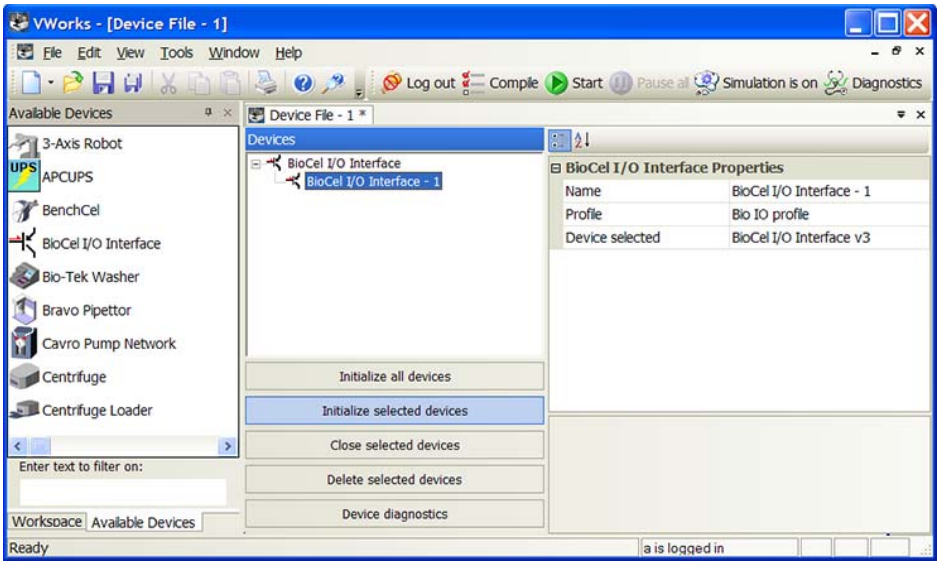
- Managing signals for lights and sound
- Managing signals to monitor the safety interlock status
- Managing signals for automated doors

Note: The IO Manager is for digital signals only.

Managing signals for lights and sound

To specify the signals for turning on lights or creating sound:

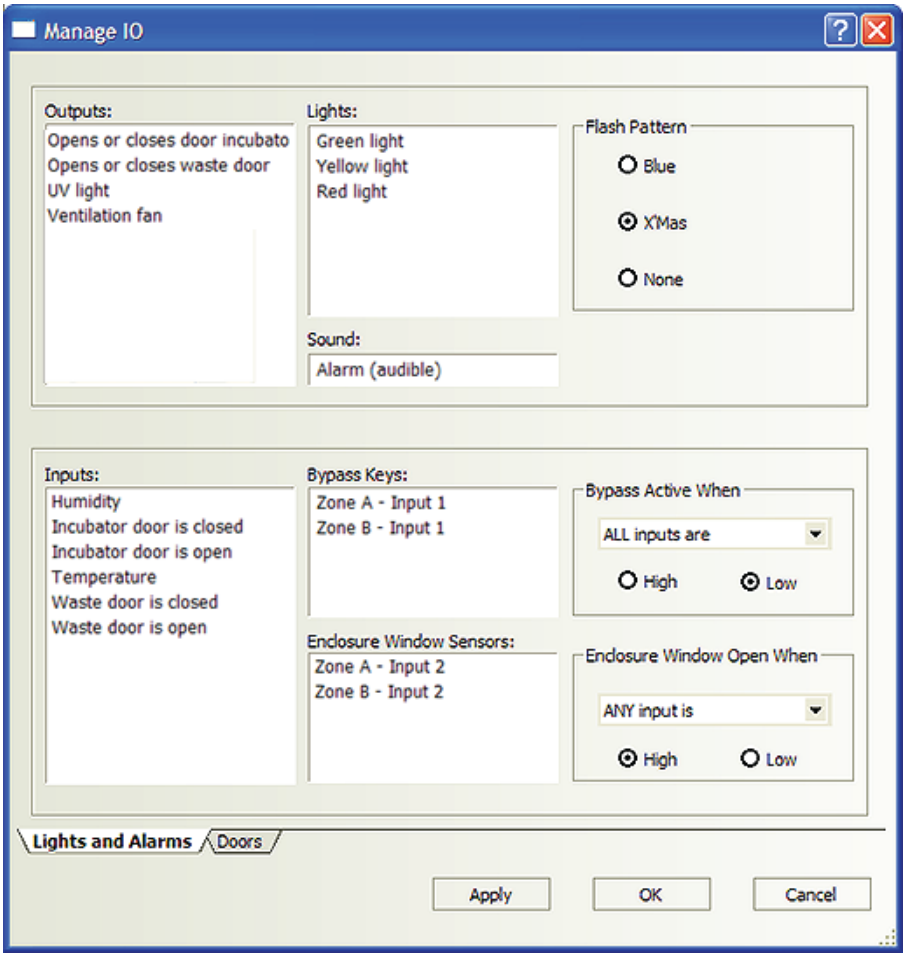
1 In the **VWorks** window, select the BioCel I/O Interface device, and then click **Initialize selected devices.**



2 Select **Tools > Manage IO.** The Manage IO dialog box opens.

3 Click the **Light and Alarm** tab. Notice the following:

- The **Outputs** list contains the digital output channels.
- The **Inputs** list contains the digital input channels.
- For BioCel I/O Interface v3 devices, only the channels that were assigned names appear in this dialog box.
- For BioCel I/O Interface v2 devices, all channels appear in this dialog box.

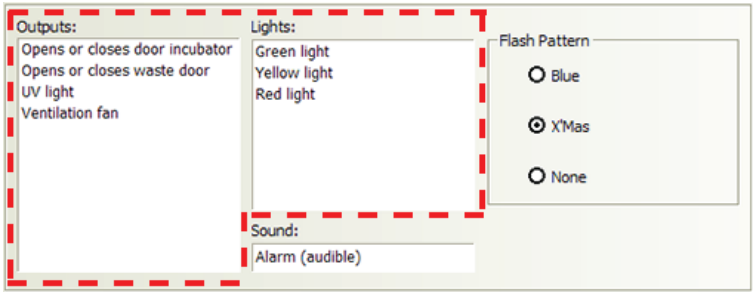


4 In the **Outputs** area, specify the output signals that will turn on lights or create sounds:

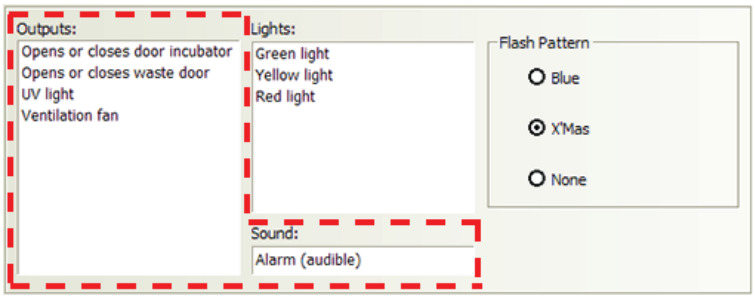
a Drag names of channels that should turn on lights into the **Lights** box. Select the type of light you want to use: **Blue** or **X'Mas** (red, green, and yellow).

If your system does not use lights to indicate output signals, select **None** under **Flash Pattern**.

Note: To use the Blue light, you must have eight channels, one for each of the eight blue status lights at the top corners of the BioCel System. To use the X'mas lights, you need three channels, one for each of the colored lights: red, green, and yellow.



b Drag names of channels that should create sounds into the **Sound** box.



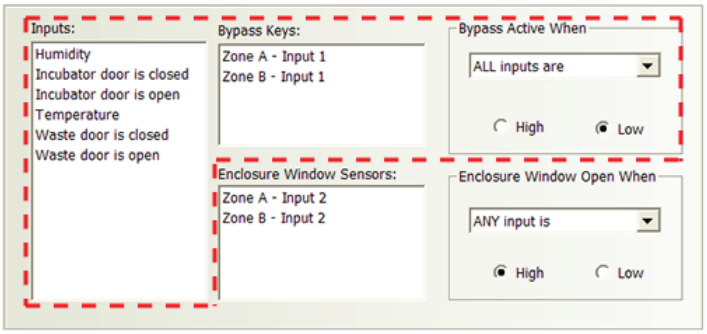
Managing signals to monitor the safety interlock status

In the Manage IO dialog box, you can specify the signals to use to monitor the status of the safety interlock and enclosure windows.

To specify the safety interlock and enclosure window signals:

1 In the **Inputs** area, drag the safety interlock channel or channels into the **Bypass Keys** box.

If the BioCel System consists of multiple connecting systems, make sure you drag the interlock channel from each system into the Bypass Keys area. In the following example, Zone A - Input 1 and Zone B - Input 1 are the interlock signals for systems A and B, respectively.



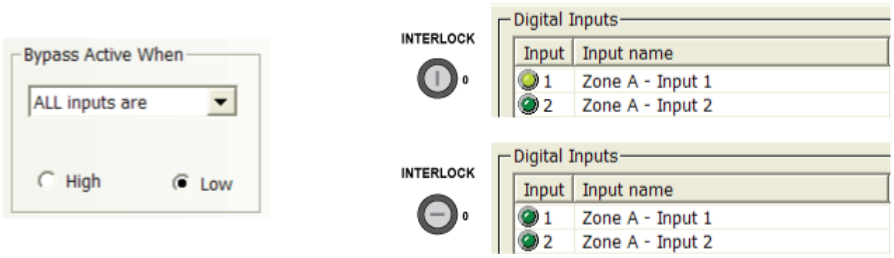
2 In the **Bypass Active When** area, select when the interlock state should be ignored: when **ANY input is** (any one signal) or when **ALL inputs are** (all signals) in a designated state.

Always select **ALL inputs are.** The system should always bypass the safety interlock if all the interlock input signals are in the specified state.

3 In the **Bypass Active When** area, select the state that indicates the safety interlock should be bypassed: **High** (status light is on)or **Low** (status light is off).

Always select **Low.** All systems are physically wired such that when the interlock is turned on at the power panel, the interlock status light in the BioCel IO Interface Diagnostics is on (High). When the interlock is turned off (bypassed), the status light is off (Low).

In the following example, Zone A - Input 1 is the signal for the safety interlock.

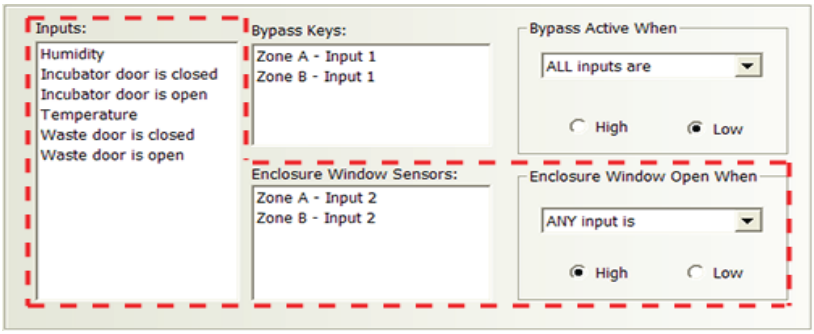


Managing signals to monitor the enclosure-window status

To set the enclosure window state:

1 In the **Inputs** area, drag the enclosure-window channel or channels into the **Enclosure Window Sensors** box.

If the BioCel System consists of multiple connecting systems, make sure you drag the enclosure-window channel from each system into the Enclosure Window Sensors area. In the example shown, Zone A - Input 2 and Zone B - Input 2 are the enclosure-window signals for systems A and B, respectively.



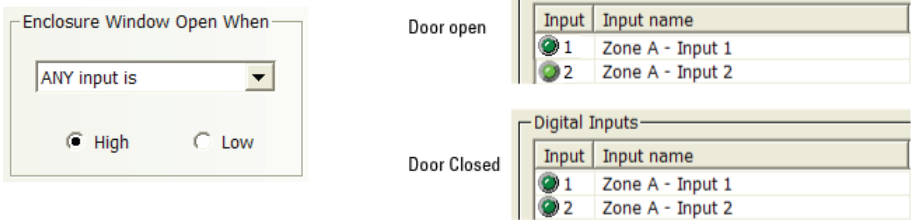
2 In the **Enclosure Window Open When** area, select one of the following: when **ANY input is** (any enclosure window) or when **ALL inputs are** (all enclosure windows) in a designated state.

Always select **Any input is.** The safety interlock circuit should stop system operations when any enclosure window is opened.

3 In the **Enclosure Window Open When** area, select the state that indicates the enclosure window is open: **High** (status light is on) or **Low** (status light is off).

Always select **High.** All systems are physically wired such that when an enclosure window is opened, the status light in the BioCel IO Interface Diagnostics is on (High). When all enclosure windows are closed, the status light is off (Low).

In the following example, Zone A - Input 2 is the signal for the enclosure windows.



Managing signals for automated doors

Some BioCel Systems have an environmental-control option that creates fully contained environments within the system chamber. Automated doors can be used to permit labware to move between the system and separated devices while maintaining the enclosed environment. Separated devices include an incubator below the system table or next to the system, the Linear Translator that moves labware between two connecting systems, the waste bin below the system table, and so on.

For each separated device that sits just beyond an automated door, make sure you:

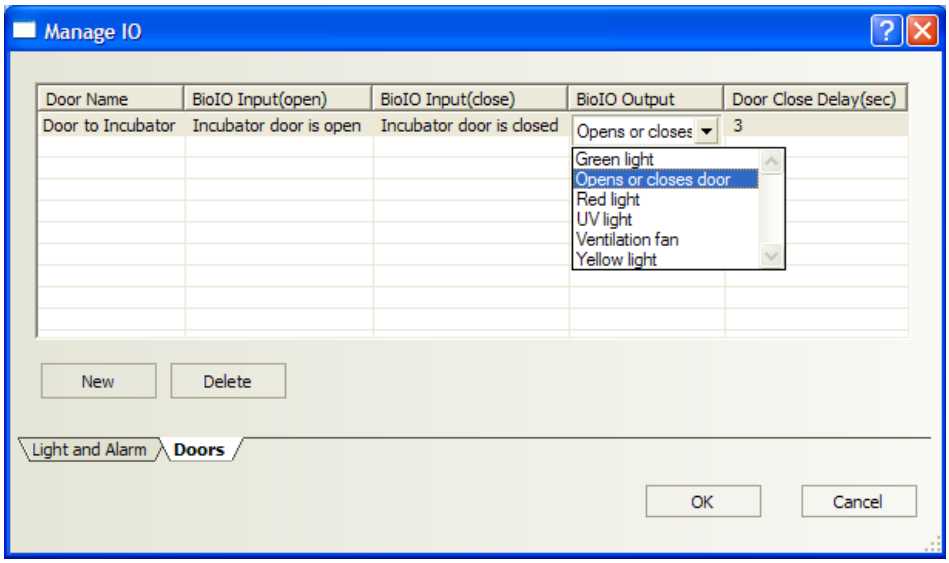
- Set up the signals for the automated door in the BioCel I/O Interface Diagnostics **Digital I/O** tab. For each door, two input signals and one output signal are required. One input signal is used to detect whether the door is open. Another input signal is used to detect whether the door is closed. The output signal is used to open or close the door, depending on the control signal received.
- Select the signals that will be used to automate the door actions.
- Associate the door to a device.
- Specify the signals to use to automatically open or close doors during a run.

To select signals to automate door actions:

1 In the Manage IO dialog box, click the **Doors** tab.

2 Click **New** to add a door.

3 Specify the following:



Parameter	Description
Door Name	The name of the door. Double-click in the field to type the name.
BioIO Input(open)	The I/O signal that detects whether the door is open. The value for this parameter must match the assignment in BioCel I/O Interface Diagnostics. Click the field to display the list of named signals and select one. If you do not see the signals in the list, initialize the BioCel I/O Interface device.
BioIO Input(close)	The I/O signal that detects whether the door is closed. The value for this parameter must match the assignment in BioCel I/O Interface Diagnostics. Click the field to display the list of named signals and select one. If you do not see the signals in the list, initialize the BioCel I/O Interface device.
BioIO Output	The I/O signal that changes to open or close the door. The value for this parameter must match the assignment in BioCel I/O Interface Diagnostics. Click the field to display the list of named signals and select one. If you do not see the signals in the list, initialize the BioCel I/O Interface device.
Door Close Delay (sec)	The length of time, in seconds, between when the robot moves labware through the doorway and when the door closes. Double-click in the field to type an integer.

4 When you are finished, click **OK** to save the changes and return to the VWorks window.

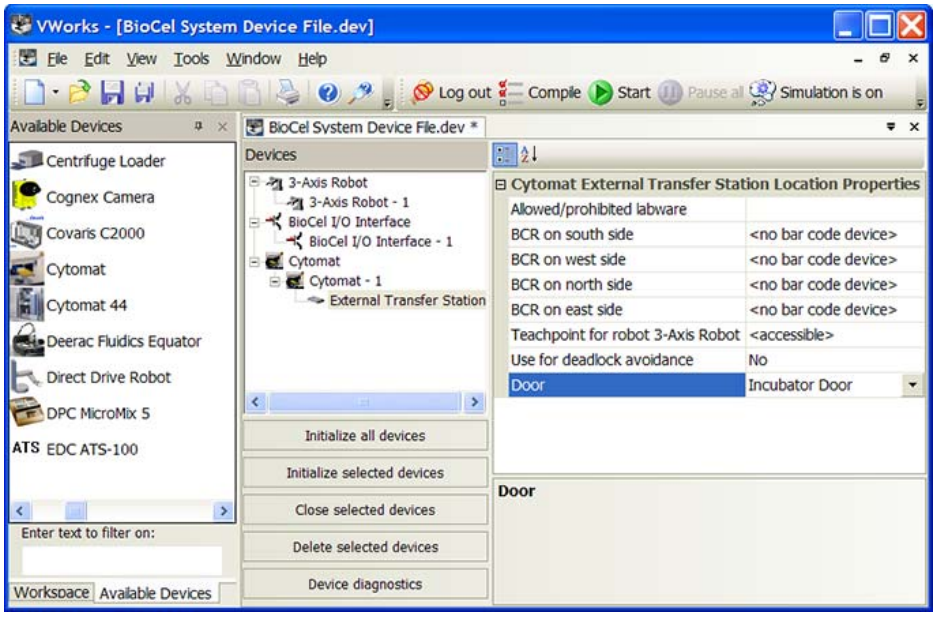
To associate the door to a device:

1 In the device file, select the device.

2 In the device properties area, select the door associated with the device.

Note: You can open the IO Manager from the device properties area to edit or add doors. From the **Door** list, click **<Edit...>.**

In the following example, an automated door was set up in the BioCel I/O Interface and IO Manager for the Cytomat incubator device. The door that was defined for the incubator in the IO Manager must be selected in the Cytomat device properties area.



Troubleshooting I/O channels

You can use BioCel I/O Interface Diagnostics to check the I/O channels for troubleshooting purposes.

BioIO 3 device

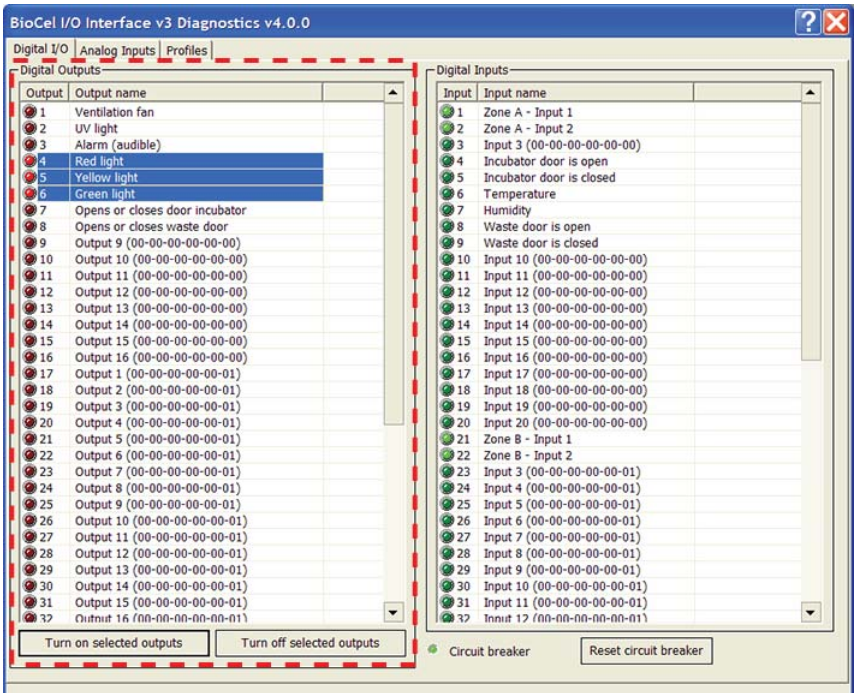
To troubleshoot BioCel I/O Interface v3 channels:

1 With the device file open, select the BioCel I/O Interface device, and then click **Device diagnostics.** Alternatively, you can double-click the device icon. The BioCel I/O Interface Diagnostics dialog box opens.

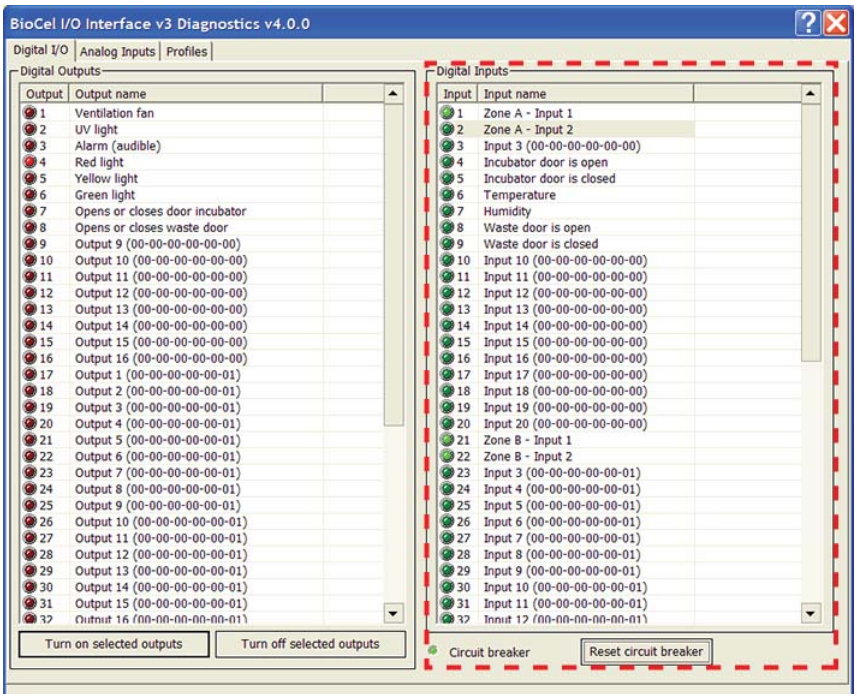
2 Click the **Digital I/O** tab.

3 In the **Digital Outputs** area, do one of the following:

- Select the single output channel you want to check, and then click the status light next to it to turn it on or off.
- SHIFT+click multiple output channels, and then click **Turn on selected outputs** or **Turn off selected outputs.** The lights adjacent to the selected channels turn on or off accordingly.



4 In the **Digital Inputs** area, check the indicator light next to the channel name to verify that the sensor is functioning correctly. For example, you can open or close an enclosure window, and then check the indicator light to see if it is turned on (window open) or off (window closed).



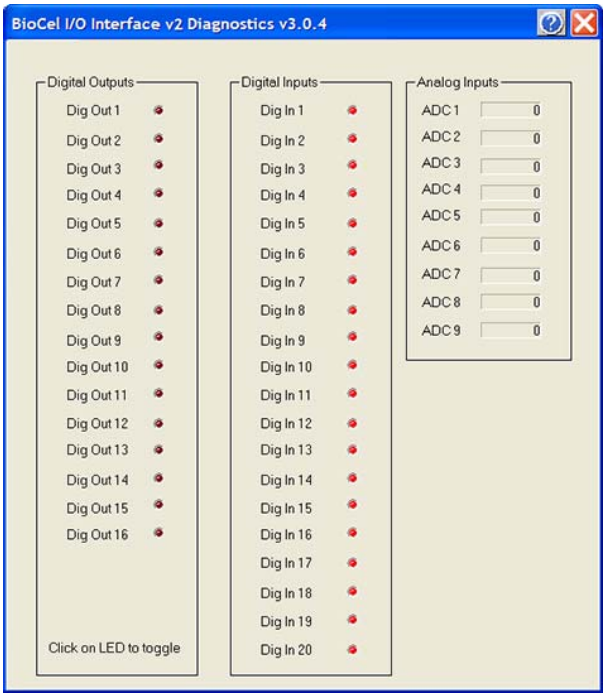
5 To reset the circuit breaker, click **Reset circuit breaker.**

BioIO 2 device

To troubleshoot BioCel I/O Interface v2 channels:

1 With the device file open, select the BioCel I/O Interface device, and then click **Device diagnostics.** The BioCel I/O Interface Diagnostics dialog box opens.

2 Click the light indicator next to the channel name to turn it on or off.



Related information

For information about...	See...
Location of the BioCel I/O Interface console	"Communication hubs" on page 18
Status light description	"Status lights" on page 19
Writing protocols	*VWorks Automation Control User Guide*
I/O-handling tasks	*VWorks Automation Control User Guide*

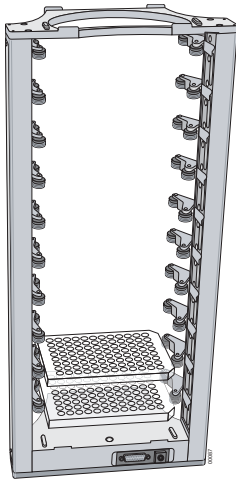
Lid Hotel Station

About this topic

This topic describes the Lid Hotel Station, explains its use, and provides the configuration instructions.

Description

The Lid Hotel Station[1] is a vertical rack that holds microplate lids while the microplates are processed. Rollers at each storage bay (or slot) hold onto a lid while the robot pulls the microplate downward to remove the lid. When the microplate returns to the storage bay, the robot pushes the microplate upward for relidding, and then pulls the lidded microplate out of the bay.



[1] Concept developed by Novartis Pharma AG, NIBR/DT/IAT, Basel, Switzerland.

Setup workflow

Step	Procedure	See...
1	Install the Lid Hotel Station.	Automation Solutions Technical Support
2	Add the Lid Hotel Station in the device file.	“Adding the Lid Hotel Station in the device file” on page 267
3	Create a profile for the Lid Hotel Station.	“Creating a profile for the Lid Hotel Station” on page 268
4	Set, edit, and verify the teachpoint for each storage bay (slot).	“Setting storage bay teachpoints” on page 270

Adding the Lid Hotel Station in the device file

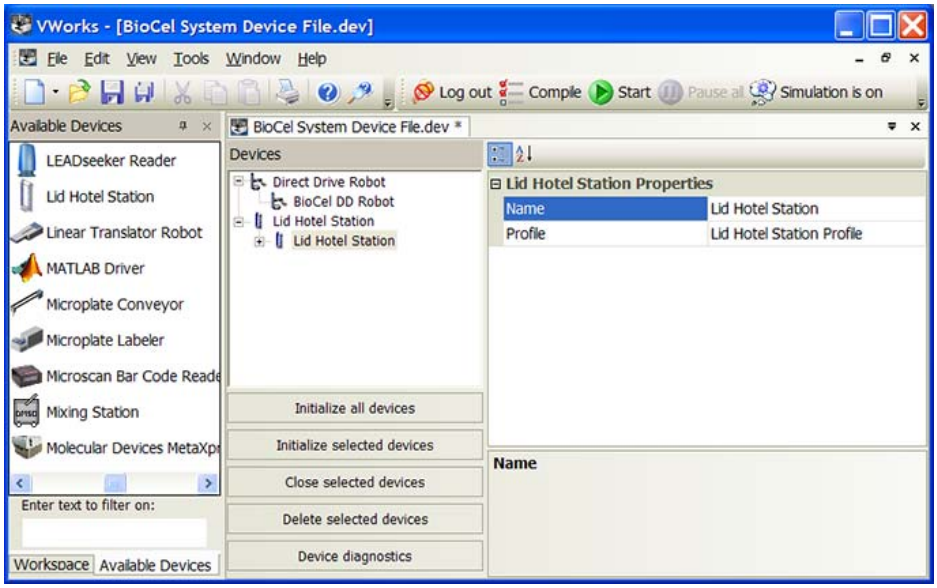
The VWorks software is set up with the correct device configuration to communicate with the Lid Hotel Station. You do not need to add a new Lid Hotel Station to the device file unless you want to reference different profiles or use a different teachpoint file. For information about profiles and device files, see "Devices and device file defined" on page 39.

Note: After adding the Lid Hotel Station, you must add each storage bay (slot) as a device to the device file.

To add the Lid Hotel Station to the device file:

1 In the VWorks software, open the device file and add the Lid Hotel Station. See "Adding and deleting devices in the software" on page 39 for instructions.

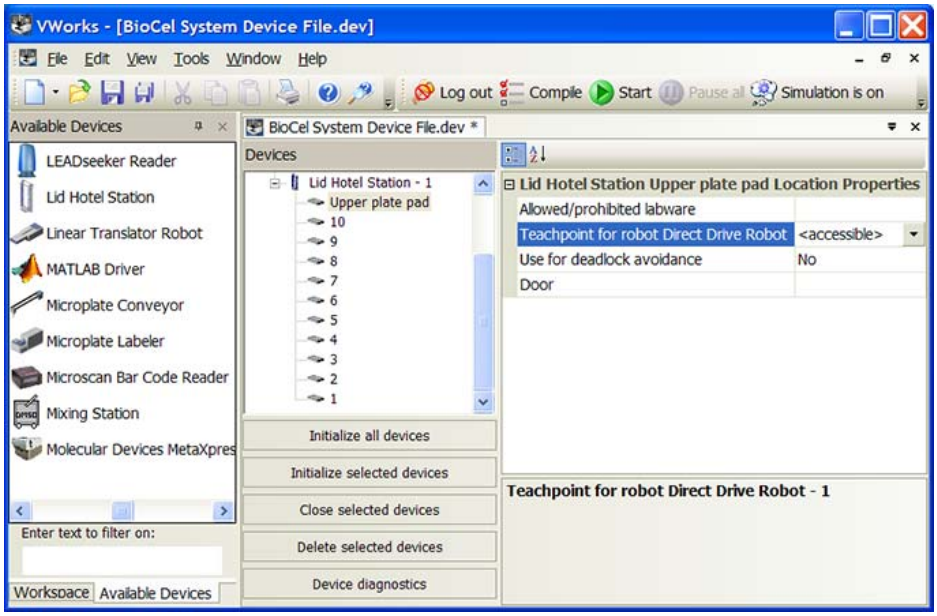
2 In the **Lid Hotel Station Properties** area, type or select the following:



Property	Description
Name	The name of the Lid Hotel Station device.
Profile	The profile associated with the device. Select the desired profile from the list. If you have not created a profile, see "Creating a profile for the Lid Hotel Station" on page 268, and then return to this step to select the profile.

3 In the **Devices** area, expand Lid Hotel Station, and then select a storage bay (slot) number.

4 In the **Lid Hotel Station Properties** area, type or set the following:



Property	Description
Allowed/prohibited labware	Permitted labware class for the selected location. For example, you might specify that only tipboxes are allowed at a given location. For details on labware classes, see the *VWorks Automation Control Setup Guide*.
Teachpoint for robot <BioCel System Robot>	The name of the teachpoint for the stage location. This selection enables the robot to move correctly to and from the storage bay (slot) during a protocol run. For example, if the robot teachpoint file contains a teachpoint for this slot, you must select that teachpoint. *Note:* In simulation mode, select **<accessible>.**
Use for deadlock avoidance	Option to permit the location to be used for deadlock avoidance. **IMPORTANT** Always select **No** for the Lid Hotel Station.

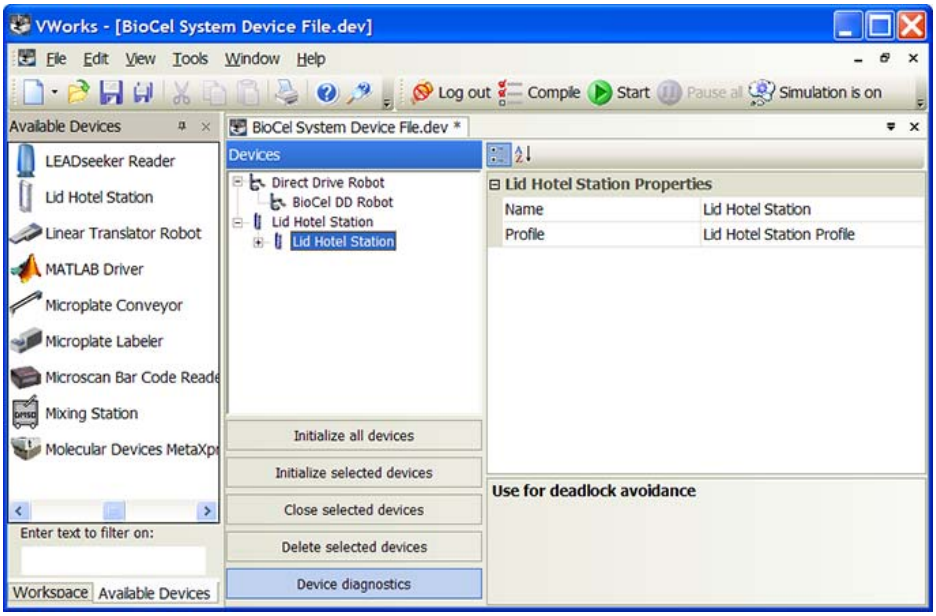
5 Select **File > Save.**

Creating a profile for the Lid Hotel Station

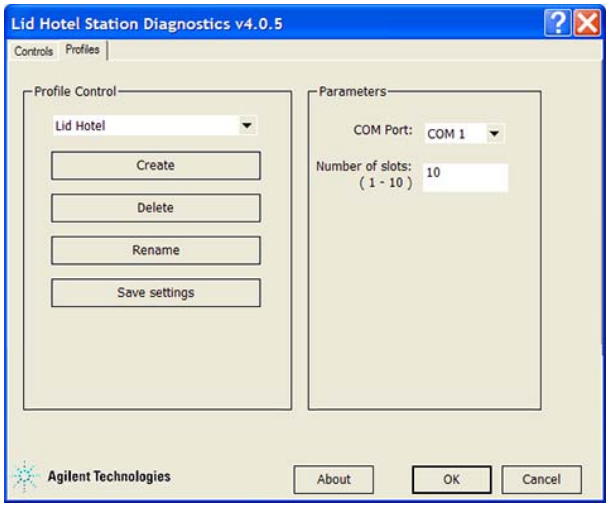
The Lid Hotel Station profile allows you to set up communication between the Lid Hotel Station and the controlling computer. You can also indicate the number of hotel slots that will be used.

To create a profile:

1 In the VWorks software, open **Lid Hotel Station Diagnostics.**



2 The Lid Hotel Station Diagnostics dialog box opens.



3 Click the **Profiles** tab.

4 Click **Create.** The New Profile dialog box opens.

5 Type a name for the new profile, and then click **OK.** The new profile name appears in the Profile Control area.

6 In the **Parameters** area:

- In the **COM Port** list, select the serial port that connects the Lid Hotel Station to the controlling computer.
- In the **Number of slots** box, type the number of storage bays in the hotel. This number should match the number of storage bays you added in the device file.

7 Click **Save settings.**

Setting storage bay teachpoints

To set teachpoints for the storage bays (slots) in the hotel, see one of the following:

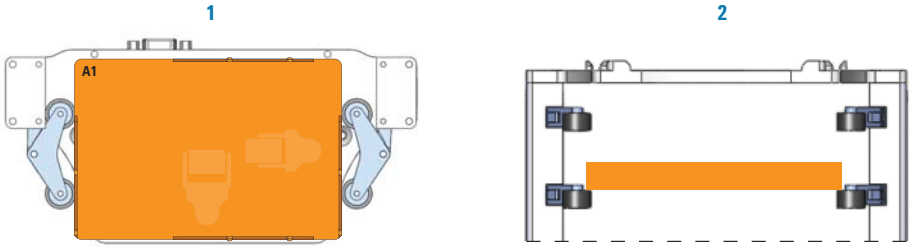
- "Setting Direct Drive Robot teachpoints" on page 69
- "Setting 3-Axis Robot teachpoints" on page 117
- "Setting KiNEDx Robot teachpoints" on page 135

Direct Drive Robot procedure

When you set the storage bay (slot) teachpoints:

1. Use the provided teaching jig to set a teachpoint at the top of the hotel. The platepad at the top of the hotel is similar to a standard platepad, so set the teachpoint as if it is a standard platepad.
2. With the teaching jig still in the robot grippers, position the robot such that the teaching jig is centered within the rollers (top view, 1), and the bottom of the teaching jig is touching the top of the rubber rollers at the desired storage bay (side view, 2).

   Note: If you are using a labware to set the teachpoints, make sure the gripper offset is at least 5 mm.



3. Set the teachpoint. Make sure you:
   - Set **Approach Ht (with labware)** and **Approach Ht (no labware)** at 0.
   - For **Pick Custom Action,** select **Lid Hotel relid.**
   - For **Place Custom Action,** select **Lid Hotel delid.**
4. Repeat steps 2 and 3 for the remaining storage bays (slots).

3-Axis Robot and KiNEDx Robot procedure

When you set the storage bay (slot) teachpoints:

1. Use the provided teaching jig to set a teachpoint at the top of the hotel. The platepad at the top of the hotel is similar to a standard platepad, so set the teachpoint as if it is a standard platepad.
2. Open the robot grippers and remove the teaching jig.
3. Without using the teaching jig, teach the top-most storage bay (Bay 10, which is the first bay under the hotel platepad) as follows:
   - **a** Jog the robot approximately 80 mm away from the hotel (or until the robot grippers are clear of the hotel).
   - **b** Jog the robot down approximately 40 mm.
   - **c** Jog the robot approximately 80 mm toward the hotel so that the robot grippers are in the target storage bay (slot).

4 Refine the robot position as follows: Make sure the bottom of the rollers are not quite touching the top of the robot grippers. If possible, jog the robot only along the *z*-axis.

5 Set the teachpoint.

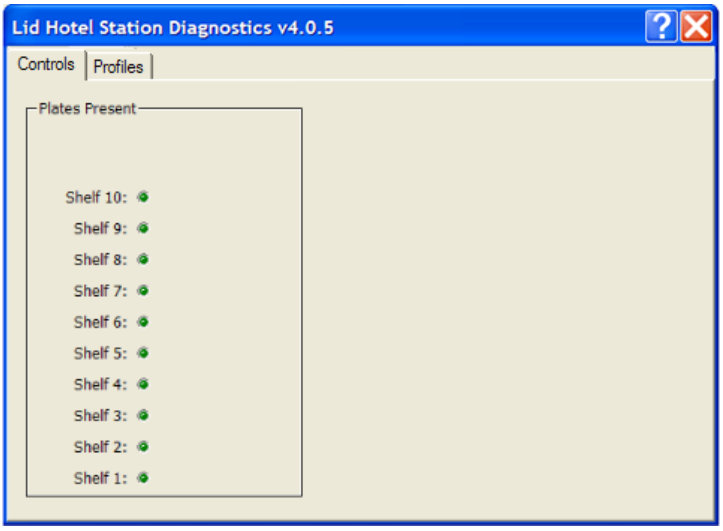
6 Repeat steps 3 through 5 for the remaining storage bays (slots).

Monitoring the hotel-slot status

Sensors at each hotel storage bay (slot) detect the presence of a lid, and the software displays the status in Lid Hotel Diagnostics.

To view the hotel storage bay (slot) status:

In **Lid Hotel Diagnostics,** click the **Controls** tab. The list of storage bays (slots) and corresponding indicator lights are displayed in the Plates Present area. If a bay (slot) is occupied, the corresponding light turns on.



Related information

For information about...	See...
Using the Lid Hotel Station in a protocol	*VWorks Automation Control User Guide*
Vacuum Delid Station	"Vacuum Delid Station" on page 332
Available devices	"BioCel System additional devices overview" on page 242

Linear Translator

About this topic

This topic describes the Linear Translator, explains its use, and provides the configuration instructions.

Description

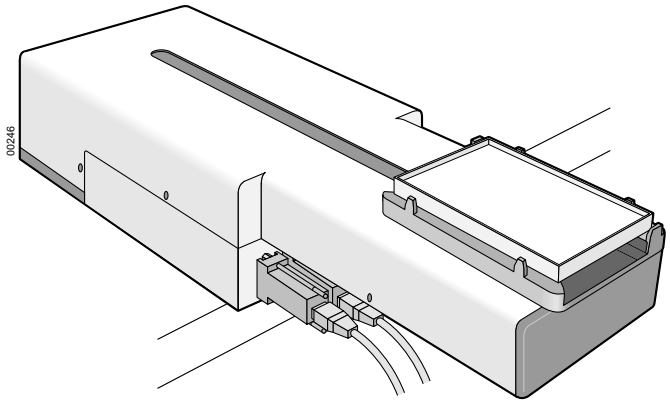
The Linear Translator has a fixed-length body with motorized plate stage that transports a microplate in one of the following ways:

- Between two robots residing in adjacent BioCel Systems
- Between a BioCel System robot and an incubator that has its own robot

The translator has two axes that enable two types of movements:

- Transports microplates linearly along the mover.
- Rotates microplates in any orientation at both ends of the mover.

Enabling microplate rotation accommodates different device or robot-access requirements. For example, the incubator at one end of the translator might require landscape microplate-orientation while the robot at the opposite end of the mover might require the microplate to be at a specific angle.



Setup workflow

Step	Procedure	See...
1	Install the Linear Translator.	Automation Solutions Technical Support
2	Add the Linear Translator in the device file.	"Adding the Linear Translator to the device file" on page 273

Step	Procedure	See...
3	Create a profile for the Linear Translator.	"Creating a profile for the Linear Translator" on page 277
4	Set and edit the teachpoints for the Linear Translator.	"Setting teachpoints for the translator" on page 280
5	Verify the Linear Translator teachpoints.	"Verifying translator teachpoints" on page 281

Adding the Linear Translator to the device file

The VWorks software is set up with the correct device configuration to communicate with the Linear Translator. You do not need to add a new Linear Translator to the device file unless you want to reference different profiles or use a different teachpoint file. For information about device files and profiles, see "Devices and device file defined" on page 39.

When setting up the Linear Translator, you must:

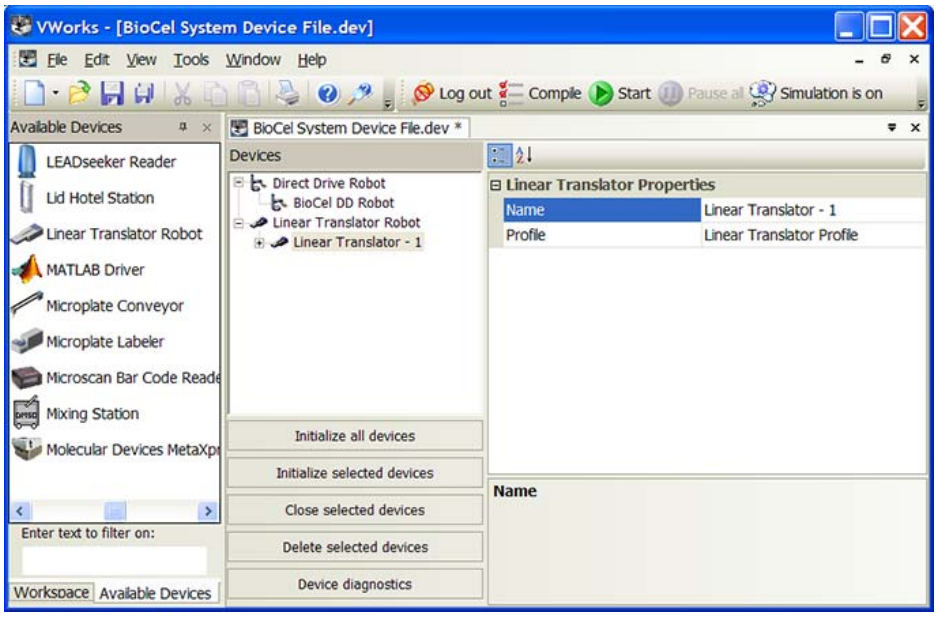
1 Add the Linear Translator in the device file and specify how the translator will interact with the BioCel System robot.

2 Revise the incubator device properties to specify how the translator will interact with the incubator.

To add the Linear Translator to the device file:

1 In the VWorks software, open the device file and add the Linear Translator. See "Adding and deleting devices in the software" on page 39 for instructions.

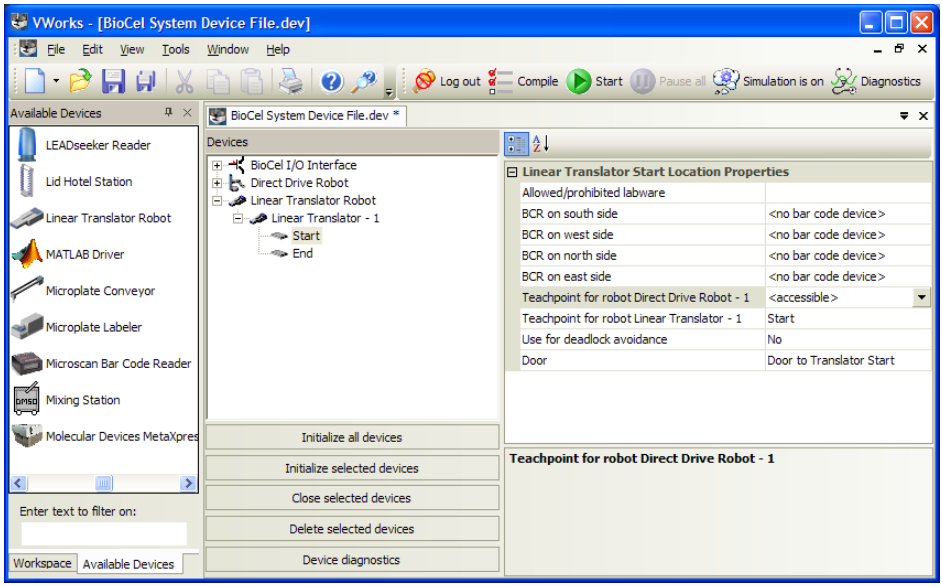
2 In the **Linear Translator Properties** area, type or select the following:



Property	Description
Name	The name of the Linear Translator device.
Profile	The profile associated with the device. Select the desired profile from the list. If you have not created a profile, see "Creating a profile for the Linear Translator" on page 277, and then return to this step to select the profile.

3 In the **Devices** area, expand Linear Translator, and then select the **Start** stage.

4 In the **Linear Translator Properties** area, set up the end that will interact with the BioCel System robot:

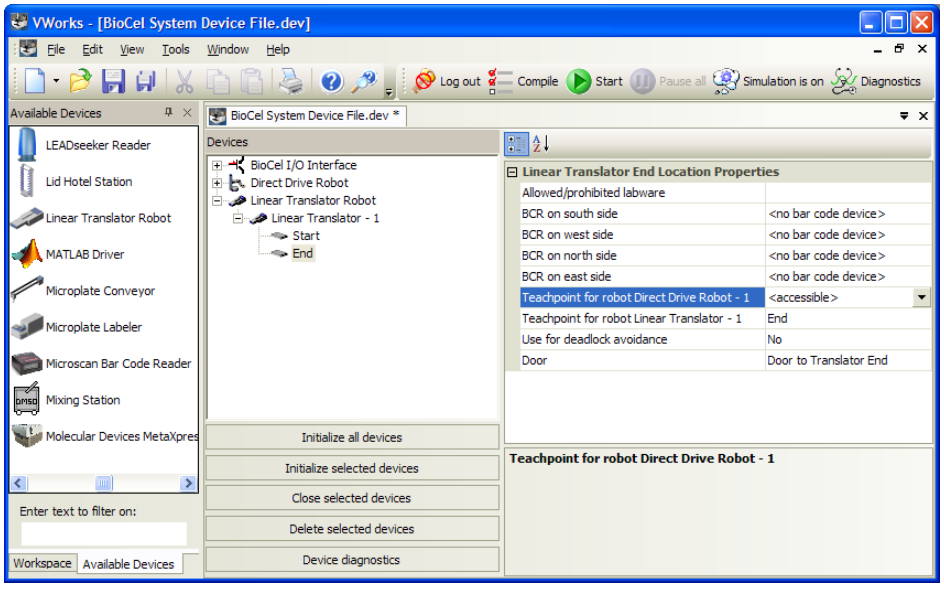


Property	Description
Allowed/prohibited labware	Permitted labware class for the selected location. For example, you might specify that only tipboxes are allowed at a given location. For details on labware classes, see the *VWorks Automation Control Setup Guide*.
BCR on south/west/north/ east side	The location of the barcode reader and the desired barcode reader device. Use these fields only if a barcode reader is installed on this device.

Property	Description
Teachpoint for robot <BioCel System Robot>	The name of the teachpoint for the Start location. This selection enables the BioCel System robot to move correctly to and from the Start location during a protocol run. For example, if the robot teachpoint file contains a teachpoint for this location, you must select that teachpoint. *Note:* In simulation mode, select **<accessible>.**
Teachpoint for robot <Linear Translator>	The teachpoint that is set up for the Linear Translator. Select **Start.** For setup instructions, see "Setting teachpoints for the translator" on page 280.
Use for deadlock avoidance	Option to permit the location to be used for deadlock avoidance. **IMPORTANT** Always select **No** for the Linear Translator.
Door	The internal system door associated with this device. For the Linear Translator, this is one of the doors between two connecting systems.

5 In the **Devices** area, select the **End** stage under Linear Translator.

6 In the **Linear Translator Properties** area, set up the end that will interact with the incubator robot:



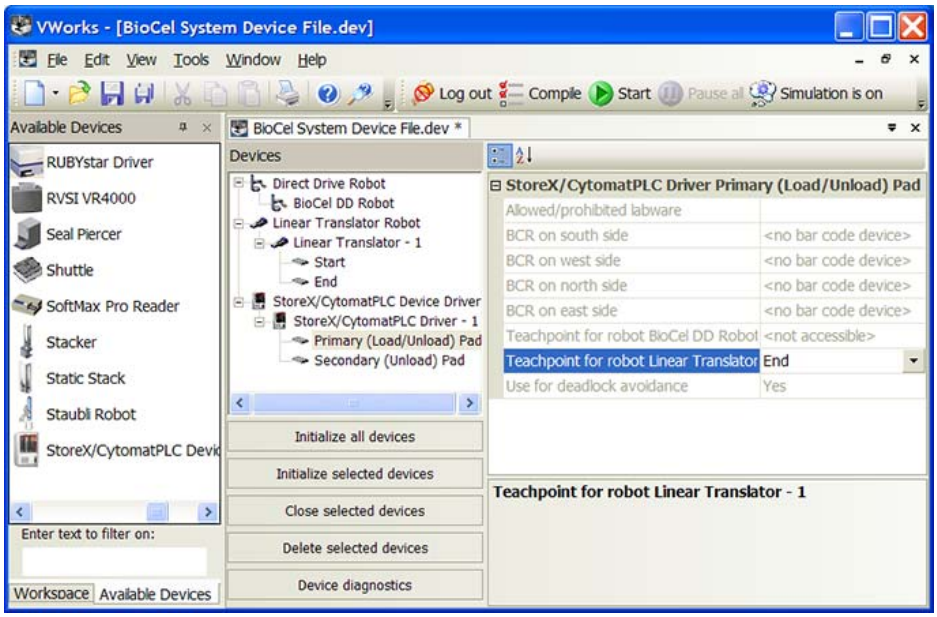
Property	Description
Allowed/prohibited labware	Permitted labware class for the selected location. For example, you might specify that only tipboxes are allowed at a given location. For details on labware classes, see the *VWorks Automation Control Setup Guide*.
BCR on south/west/north/ east side	The location of the barcode reader and the desired barcode reader device. Use these fields only if a barcode reader is installed on this device.
Teachpoint for robot <BioCel System Robot>	The name of the teachpoint for the stage location. Because the End location will only interact with the incubator, select **<not accessible>.**
Teachpoint for robot <Linear Translator>	The teachpoint that is set up for the Linear Translator. Select **End.** For setup instructions, see "Setting teachpoints for the translator" on page 280.
Use for deadlock avoidance	Option to permit the location to be used for deadlock avoidance. Select **Yes** to permit labware to be moved to this location to avoid a deadlock in the system. Select **No** if you do not want to move random labware to this location to avoid deadlock.
Door	The internal system door associated with this device. For the Linear Translator, this is one of the doors between two connecting systems.

7 Select **File > Save.**

To update the incubator device properties:

1 In the **Devices** area, expand the incubator and select the **Load/Unload** or equivalent location.

2 In the incubator Properties area, update the fields that will enable interaction with the Linear Translator:



Property	Description
Teachpoint for robot <BioCel System Robot>	Select **<not accessible>**. *Note:* In simulation mode, select **<not accessible>.**
Teachpoint for robot <Linear Translator>	Select **End,** because this is the teachpoint that is set up to interact with the incubator.

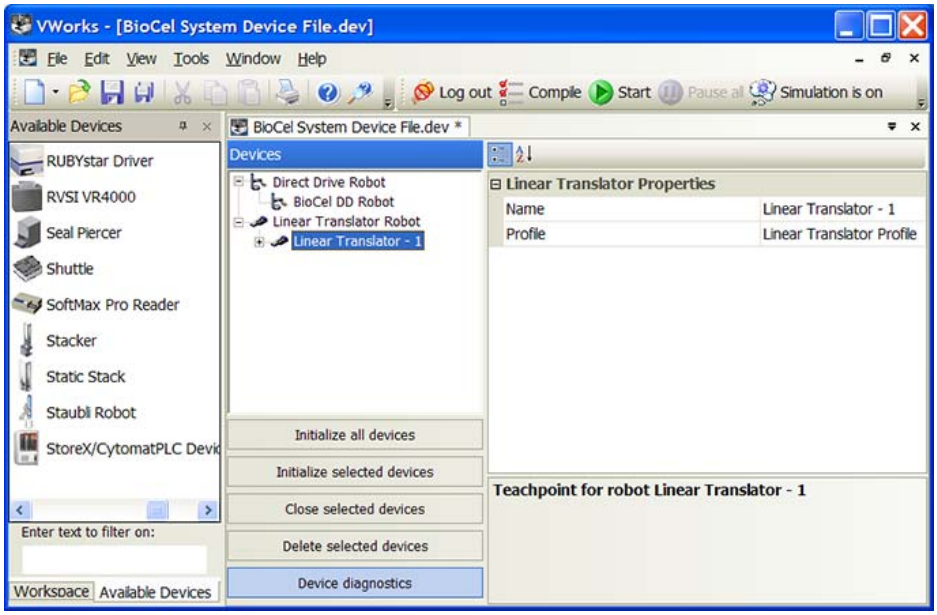
3 Select **File > Save.**

Creating a profile for the Linear Translator

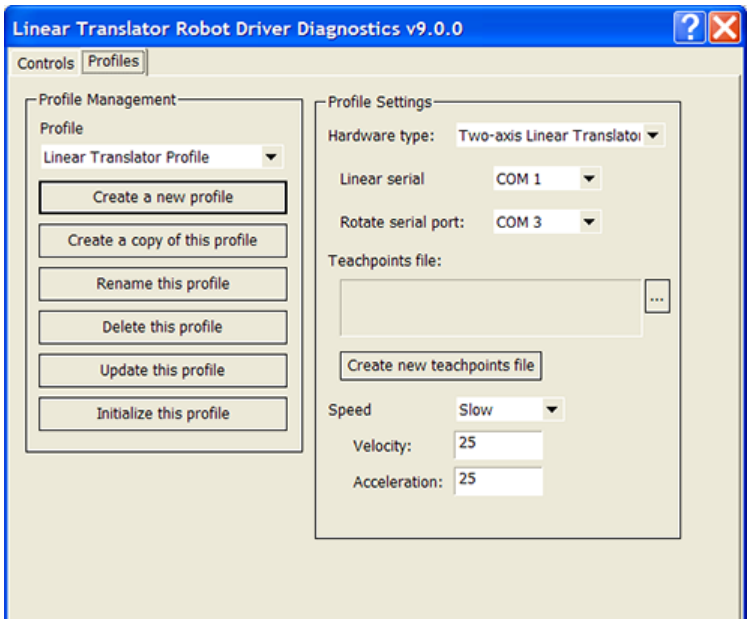
The Linear Translator profile allows you to set up communication between the translator and the controlling computer. You can also set the speed at which the translator should transport microplates.

To create a profile:

1 In the VWorks software, open **Linear Translator Robot Driver Diagnostics.**



The Linear Translator Robot Driver Diagnostics dialog box opens.

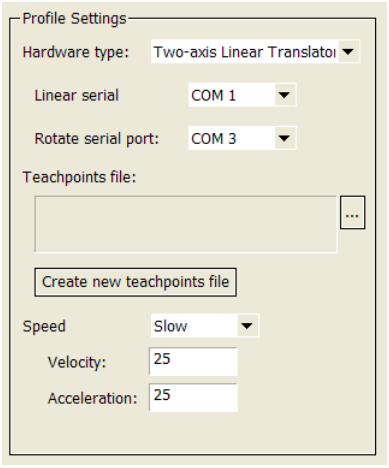


2 Click the **Profiles** tab.

3 Click **Create a new profile.** The Create Profile dialog box opens.

4 Type a name for the new profile, and then click **OK.** The new profile name appears in the Profile Management area.

5 In the **Profile settings** area, set the following parameters:



Selection or parameter	Description
Hardware type	Select **One-axis Linear Translator** or **Two-axis Linear Translator.** To determine whether the translator has two axes, try to manually rotate the plate stage. If it rotates, it has two axes.
Linear serial	Select the serial port that connects the linear motor to the controlling computer.
Rotate serial port	Select the serial port that connects the rotational motor to the controlling computer.
Teachpoint file	Browse and select the translator teachpoint file you want to use. *Note:* The translator teachpoint file is different from the system robot teachpoint file. To set up translator teachpoints, see "Setting teachpoints for the translator" on page 280.
Speed	Select the speed at which you want the translator to move: **Fast**, **Medium**, or **Slow.**
Velocity	Type the percentage of factory-set maximum speed for the speed you selected. For example, if you selected Slow, you can set the Slow speed at 15% of the factory-set maximum speed.
Acceleration	Type the percentage of maximum factory-set acceleration for the speed you selected. For example, if you selected Slow, you can set the Slow acceleration at 15% of the factory-set maximum acceleration.

6 When you are finished, click **Update this profile** to save the changes.

7 Click **Initialize this profile.**

Setting teachpoints for the translator

To set the teachpoints for the translator, you need to:

1 Use Linear Translator Diagnostics to set a teachpoint at each end of the translator. One teachpoint is accessed by the BioCel System robot, the other teachpoint is accessed by the incubator.

2 Use the instructions in one of the following topics to set a BioCel System robot teachpoint at the start location of the translator.

- "Setting Direct Drive Robot teachpoints" on page 69
- "Setting 3-Axis Robot teachpoints" on page 117
- "Setting KiNEDx Robot teachpoints" on page 135

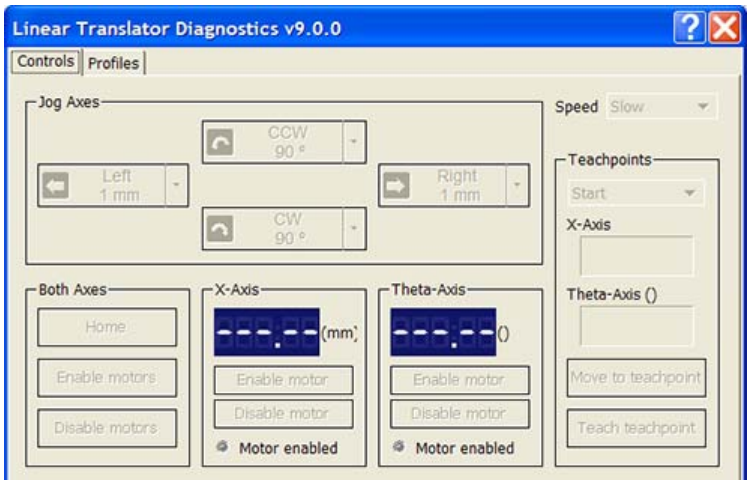
Make sure you turn off the translator motors before you start. To turn off the motors, see "Turning on and turning off the translator motors" on page 282.

3 Follow instructions in the incubator user documentation to set a teachpoint at the end location of the translator.

Make sure you turn off the translator motors before you start. To turn off the motors, see "Turning on and turning off the translator motors" on page 282.

To set the teachpoints using Linear Translator Diagnostics:

1 In **Linear Translator Diagnostics,** click the **Controls** tab.



2 In the **Both Axes** area, click **Disable motors.** The translator motors are turned off.

3 Manually push the translator plate stage to the end where the BioCel System robot will place or pick up microplates.

4 Manually move the BioCel System robot to the plate stage. Use the instructions in one of the following topics to set and edit the BioCel System robot teachpoint at the translator.
   - "Setting Direct Drive Robot teachpoints" on page 69
   - "Setting 3-Axis Robot teachpoints" on page 117
   - "Setting KiNEDx Robot teachpoints" on page 135
5 In **Linear Translator Diagnostics,** in the **Teachpoints** area, select **Start Location,** and then click **Teach teachpoint.**
6 Manually move the translator plate stage to the end where the incubator will place or pick up microplates.
7 Manually move the incubator robot to the plate stage. Use the incubator user documentation to set and edit the teachpoint at the translator.
8 In **Linear Translator Diagnostics,** in the **Teachpoints** area, select **End Location,** and then click **Teach teachpoint.**
9 In the **Both Axes** area, click **Enable motors** to turn on the translator motors.

Verifying translator teachpoints

To verify the translator teachpoints:

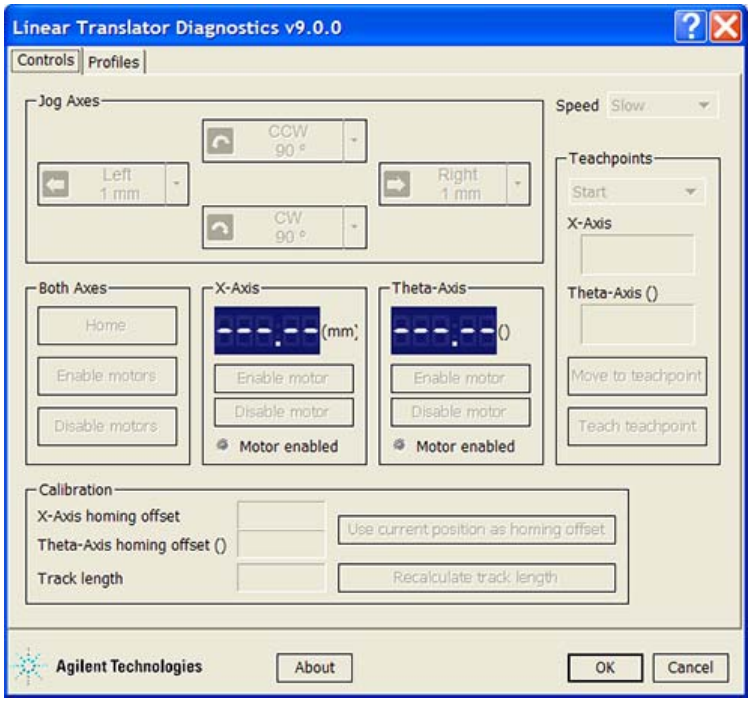
1 In **Linear Translator Driver Diagnostics,** in the **Teachpoints** area, select a teachpoint you want to verify, and then click **Move to teachpoint.** Check that the translator plate stage moved to the selected teachpoint and is positioned accurately. If necessary, edit the teachpoint (see "Setting teachpoints for the translator" on page 280).
2 For the BioCel System robot, use the instructions in one of the following sections to verify and edit the teachpoint:
   - "Verifying Direct Drive Robot teachpoints" on page 90
   - "Verifying 3-Axis Robot teachpoints" on page 124
   - "Verifying KiNEDx Robot teachpoints and waypoints" on page 143
3 For the incubator robot, follow the incubator user documentation to verify and edit the teachpoint.

Using Linear Translator Diagnostics

You can use the commands and parameters in the Linear Translator Diagnostics Controls tab to:

- Home the plate stage
- Turn on or turn off the translator motors
- Change the translator speed
- Jog the plate stage

CAUTION Use only the commands and parameters in the Controls tab as described. Do not click the buttons in the Calibration area. The Use current position as homing offset button resets the current plate stage position as the home position (0, 0). The Track length value was set at the factory and should not be changed. If you believe the Linear Translator is not working properly, contact Automation Solutions Technical Support.



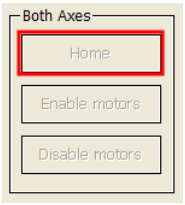
Homing the plate stage

Homing sends the plate stage to the factory-defined home position for each axis of motion. Home the plate stage when recovering from an emergency stop.

To home the plate stage:

1 In **Linear Translator Diagnostics,** click the **Controls** tab.

2 In the **Both Axes** area, click **Home.**



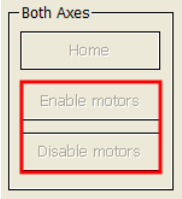
Turning on and turning off the translator motors

Turning off the translator motors allows you to move the plate stage by hand, making it easier to set and edit teachpoints. You must turn on the translator motors for operation.

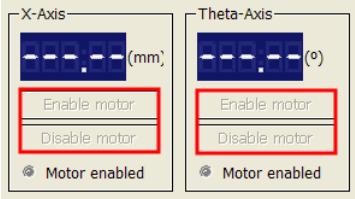
To turn on or turn off the translator motors:

In the **Both Axes** area, click one of the following:

Command	Description
Enable motors	Turns on the translator motors.
Disable motors	Turns off the translator motors.



Alternatively, you can turn on or turn off the motor of a single axis. To do this, in the **X-Axis** or **Theta-Axis** area, click either **Enable motor** or **Disable motor** to turn on or turn off the motor for that axis. The *x*-axis motor moves the plate stage linearly. The *theta*-axis motor rotates the plate stage.



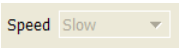
Changing the translator speed

You can select the robot speed to accommodate the task you are performing. For example, you can select the Slow speed when you are setting teachpoints or diagnosing problems.

To change the translator speed:

In the **Speed** list, select the speed at which you want the plate stage to move: **Fast, Medium,** or **Slow.**

Note: The speed you select in the Controls tab applies only to the commands you use in the diagnostics software (Jog and Move to teachpoint).



Jogging the plate stage

Jogging the translator plate stage moves the plate stage in small, precise increments along one of the axes. You can jog the plate stage to fine-tune its position when setting teachpoints.

To jog the plate stage:

In the **Jog Axes** area, click one of the following:

Command	Description
CCW	Jogs the plate stage counterclockwise by the specified increment.
CW	Jogs the plate stage clockwise by the specified increment.
Left	Jogs the plate stage left from the current position by the specified increment.
Right	Jogs the robot head right from the current position by the specified increment.

To change the jog increment, click the down arrow, and then select the desired increment in millimeters or degrees.

Related information

For information about...	See...
Using the Linear Translator in a protocol	*VWorks Automation Control User Guide*
Incubator device	Incubator device driver guide
Microplate rotators	"Microplate Shuttle and Rotator" on page 301
Available devices	"BioCel System additional devices overview" on page 242

Microplate Conveyor

About this topic

This topic describes the Microplate Conveyor, explains its use, and provides the configuration instructions.

Description

The Microplate Conveyor is a device that transports microplates in one of the following ways:

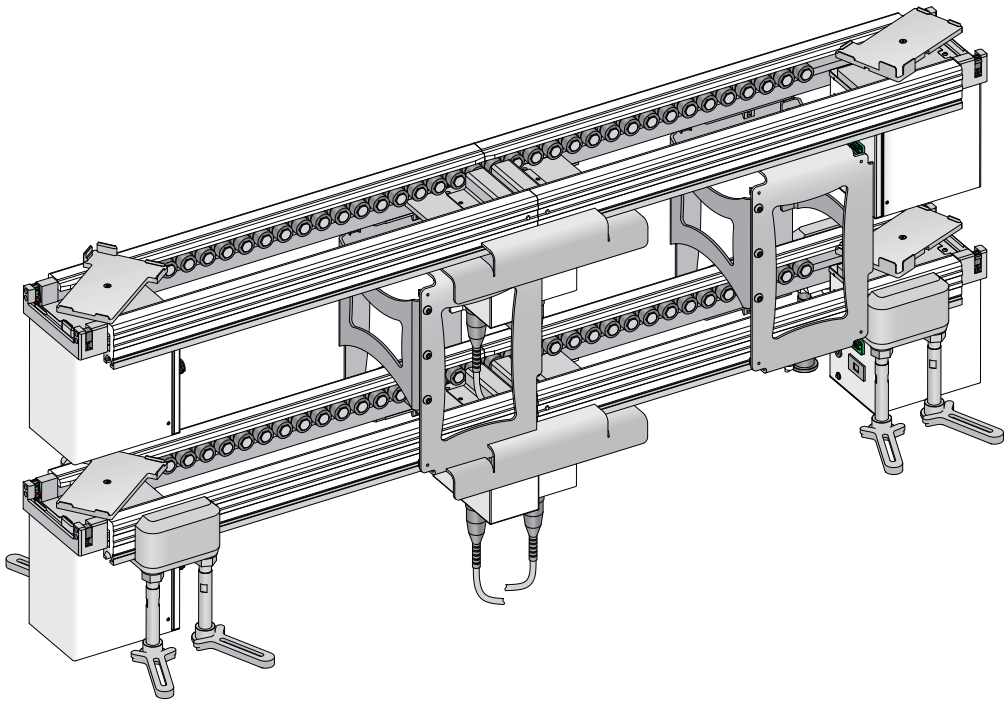
- Between two robots residing in adjacent BioCel Systems
- Between a BioCel System robot and another device that has its own robot

The Microplate Conveyor has three axes of movements:

- The plate stage at the end of the device moves vertically up and down when delivering microplates to and from the conveyor.
- The plate stage rotates microplates in any orientation to accommodate device- or robot-access requirements.
- The conveyor rollers move microplates from one end to the other when delivering microplates between two robots.

The Microplate Conveyor can be configured to meet different requirements. In most systems, the conveyor has a plate stage at both ends for transporting microplates between two robots. In some systems, the conveyor transports microplates onto a third-party conveyor that feeds the microplates to storages devices, so a plate stage is installed only at one end.

To increase throughput, two conveyors can be stacked, as the following diagram shows.



Setup workflow

Step	Procedure	See...
1	Install the Microplate Conveyor.	Automation Solutions Technical Support
2	Add the Microplate Conveyor in the device file.	"Adding the Microplate Conveyor to the device file" on page 286
3	Create a profile for the Microplate Conveyor.	"Creating a profile for the Microplate Conveyor" on page 291
4	Set and edit the teachpoints for the Microplate Conveyor.	"Setting teachpoints for the Microplate Conveyor" on page 293
5	Verify the Microplate Conveyor teachpoints.	"Verifying conveyor teachpoints" on page 294

To troubleshoot the conveyor, you use the commands and selections in Microplate Conveyor Diagnostics. For more information, see "Using Microplate Conveyor Diagnostics" on page 294.

Adding the Microplate Conveyor to the device file

The VWorks software is set up with the correct device configuration to communicate with the Microplate Conveyor. You do not need to add a new Microplate Conveyor to the device file unless you want to reference different profiles or use a different teachpoint file. For information about device files and profiles, see "Devices and device file defined" on page 39.

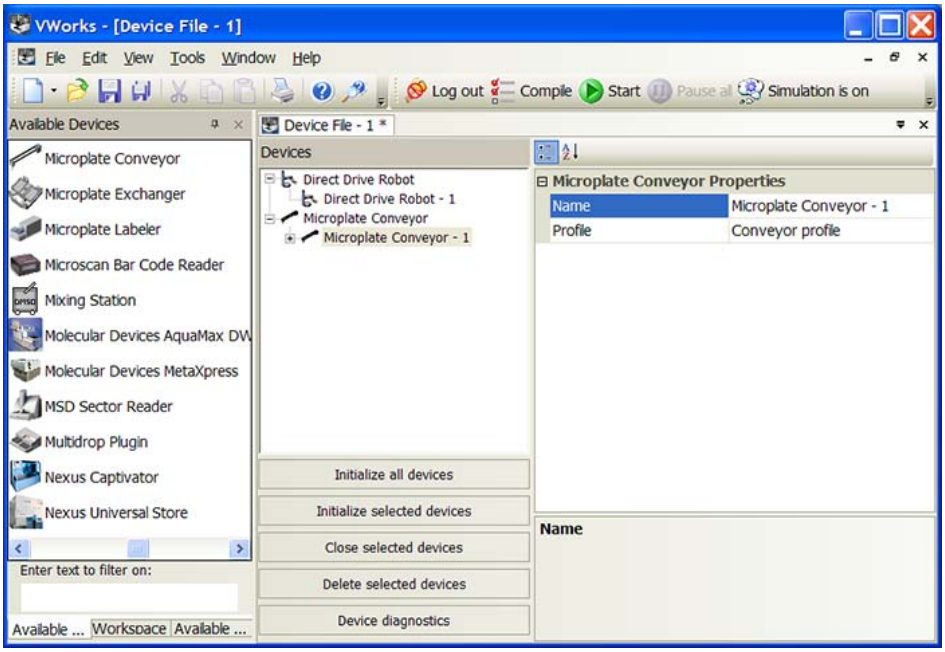
When setting up the Microplate Conveyor, you must:

1. Add the Microplate Conveyor in the device file and specify how the conveyor will interact with the BioCel System robot. See "Adding the conveyor to the device file" on page 286.
2. Revise the third-party device properties to specify how the conveyor will interact with the device. See "Revising the third-party device properties" on page 290.

Adding the conveyor to the device file

To add the Microplate Conveyor to the device file:

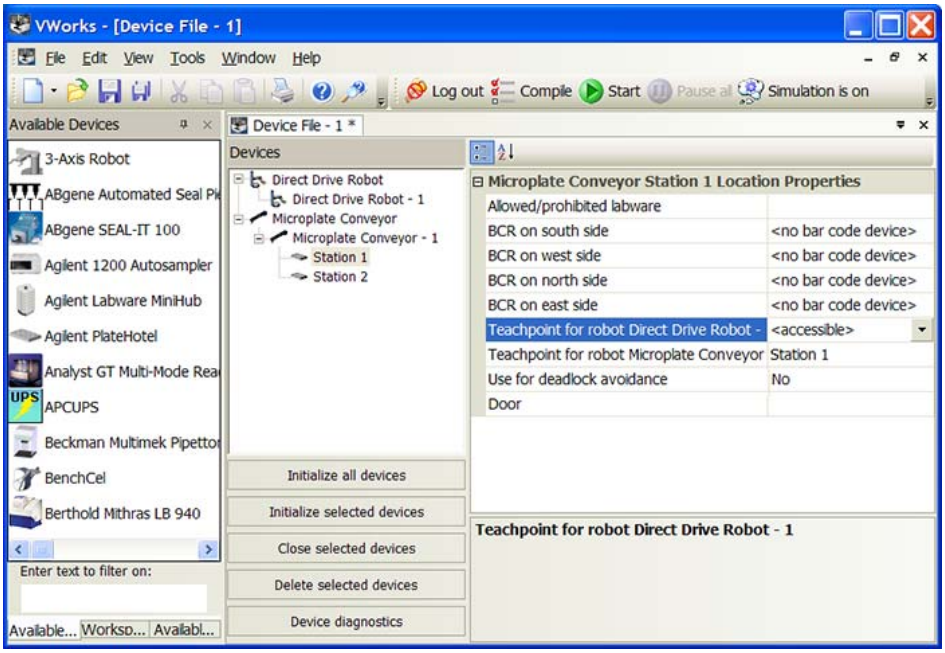
1. In the VWorks software, open the device file and add the Microplate Conveyor. See "Adding and deleting devices in the software" on page 39 for instructions.
2. In the **Microplate Conveyor Properties** area, type or select the following:



Property	Description
Name	The name of the Microplate Conveyor device.
Profile	The profile associated with the device. Select the desired profile from the list. If you have not created a profile, see "Creating a profile for the Microplate Conveyor" on page 291, and then return to this step to select the profile.

3 In the **Devices** area, expand Microplate Conveyor, and then select **Station 1**.

4 In the **Microplate Conveyor Station 1 Location Properties** area, set the parameters for the end that will interact with the BioCel System robot.

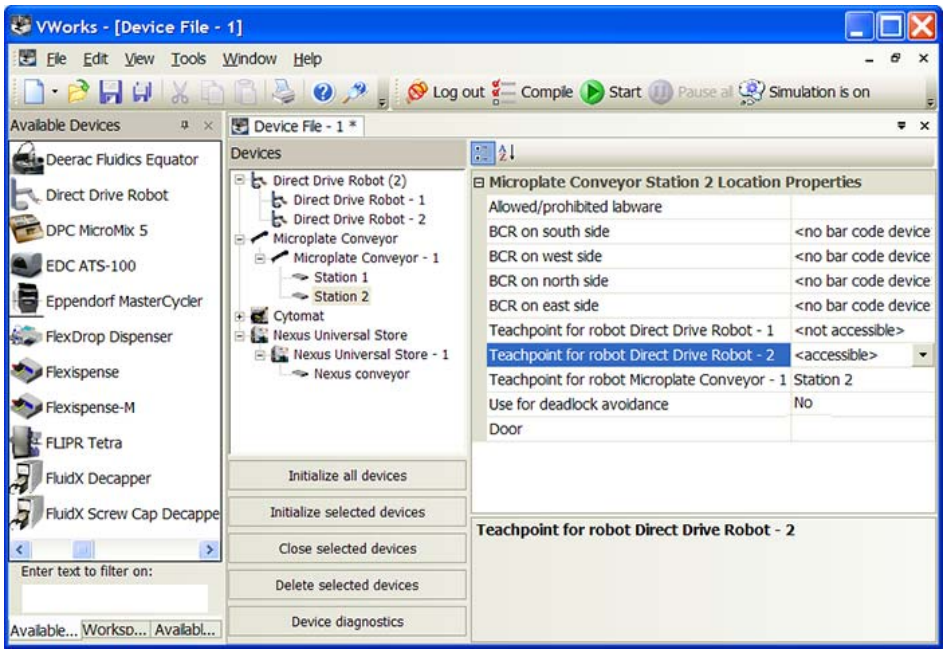


Property	Description
Allowed/prohibited labware	Permitted labware class for the selected location. For example, you might specify that only tipboxes are allowed at a given location. For details on labware classes, see the *VWorks Automation Control Setup Guide*.
BCR on south/west/north/east side	The location of the barcode reader and the desired barcode reader device. Use these fields only if a barcode reader is installed on this device.
Teachpoint for robot <BioCel System Robot>	The name of the teachpoint for the Station 1 location. This selection enables the BioCel System robot to move correctly to and from the Station 1 location during a protocol run. For example, if the robot teachpoint file contains a teachpoint for this location, you must select that teachpoint. *Note:* In simulation mode, select **<accessible>**.
Teachpoint for robot <Microplate Conveyor>	The teachpoint that is set up for the Microplate Conveyor. Select **Station 1**. For setup instructions, see "Setting teachpoints for the Microplate Conveyor" on page 293.

Property	Description
Use for deadlock avoidance	Option to permit the location to be used for deadlock avoidance. **IMPORTANT** Always select **No** for the Microplate Conveyor.
Door	The internal system door associated with this device. For the Microplate Conveyor, this is one of the doors between two connecting systems. *Note:* The door must be configured in the BioCel I/O Interface. See "BioCel I/O Interface" on page 251.

5 If the conveyor has two plate stages, in the **Devices** area, select **Station 2** under Microplate Conveyor.

6 In the **Microplate Conveyor Stage 2 Location Properties** area, set up the end that will interact with the other robot:


VWorks - [Device File - 1]
File Edit View Tools Window Help
Log out Compile Start Pause all Simulation is on
Available Devices
Deerac Fluidics Equator
Direct Drive Robot
DPC MicroMix 5
EDC ATS-100
Eppendorf MasterCycler
FlexDrop Dispenser
Flexispense
Flexispense-M
FLIPR Tetra
FluidX Decapper
FluidX Screw Cap Decappe
Enter text to filter on:
Available... Worksp... Availabl...
Device File - 1 *
Devices
Direct Drive Robot (2)
Direct Drive Robot - 1
Direct Drive Robot - 2
Microplate Conveyor
Microplate Conveyor - 1
Station 1
Station 2
Cytomat
Nexus Universal Store
Nexus Universal Store - 1
Nexus conveyor
Initialize all devices
Initialize selected devices
Close selected devices
Delete selected devices
Device diagnostics
Microplate Conveyor Station 2 Location Properties
Allowed/prohibited labware
BCR on south side <no bar code device
BCR on west side <no bar code device
BCR on north side <no bar code device
BCR on east side <no bar code device
Teachpoint for robot Direct Drive Robot - 1 <not accessible>
Teachpoint for robot Direct Drive Robot - 2 <accessible>
Teachpoint for robot Microplate Conveyor - 1 Station 2
Use for deadlock avoidance No
Door
Teachpoint for robot Direct Drive Robot - 2

Property	Description
Allowed/prohibited labware	Permitted labware class for the selected location. For example, you might specify that only tipboxes are allowed at a given location. For details on labware classes, see the *VWorks Automation Control Setup Guide*.
BCR on south/west/north/ east side	The location of the barcode reader and the desired barcode reader device. Use these fields only if a barcode reader is installed on this device.

Property	Description
Teachpoint for robot <BioCel System Robot>	The name of the teachpoint for the Station 2 location. If the Station 2 location will interact with another BioCel System robot, select the teachpoint for that robot. If the Station 2 location will only interact with the another device robot, select **<not accessible>.**
Teachpoint for robot <Microplate Conveyor>	The teachpoint that is set up for the Microplate Conveyor. If Station 2 is used, select **Station 2.** For setup instructions, see "Setting teachpoints for the Microplate Conveyor" on page 293.
Use for deadlock avoidance	Option to permit the location to be used for deadlock avoidance. **IMPORTANT** Always select **No** for the Microplate Conveyor.
Door	The internal system door associated with this device. For the Microplate Conveyor, this is one of the doors between two connecting systems. *Note:* The door must be configured in the BioCel I/O Interface. See "BioCel I/O Interface" on page 251.

7 Select **File > Save.**

Revising the third-party device properties

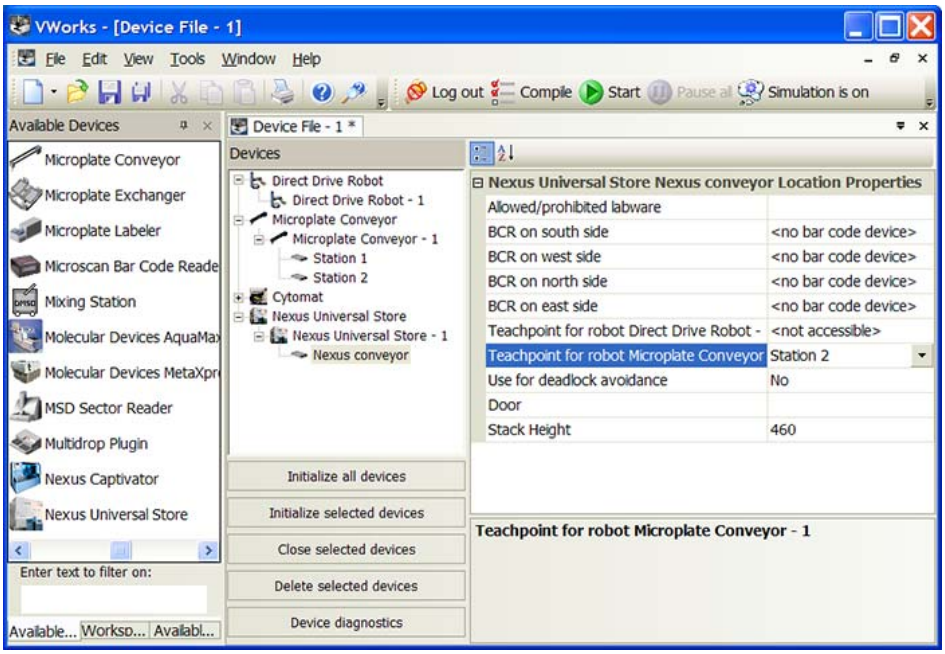
Depending on the third-party device you have installed at the Station 2 end of the conveyor, you might need to configure the third-party device to interact with the Station 2 location.

This section explains how to set the Nexus Universal Store device properties for the conveyor. For information on how to set up other devices, see the device driver user guide, or contact Automation Solutions Technical Support.

To update the Nexus Universal Store device properties:

1 In the **Devices** area, expand **Nexus Universal Store** and select the **Nexus conveyor** location.

2 In the Nexus Universal Store **Location Properties** area, update the fields that will enable interaction with the Microplate Conveyor:



Property	Description
Teachpoint for robot <BioCel System Robot>	Select **<not accessible>**. *Note:* In simulation mode, select **<not accessible>.**
Teachpoint for robot <Microplate Conveyor>	Select **Station 2,** because this is the teachpoint that will interact with the storage device.

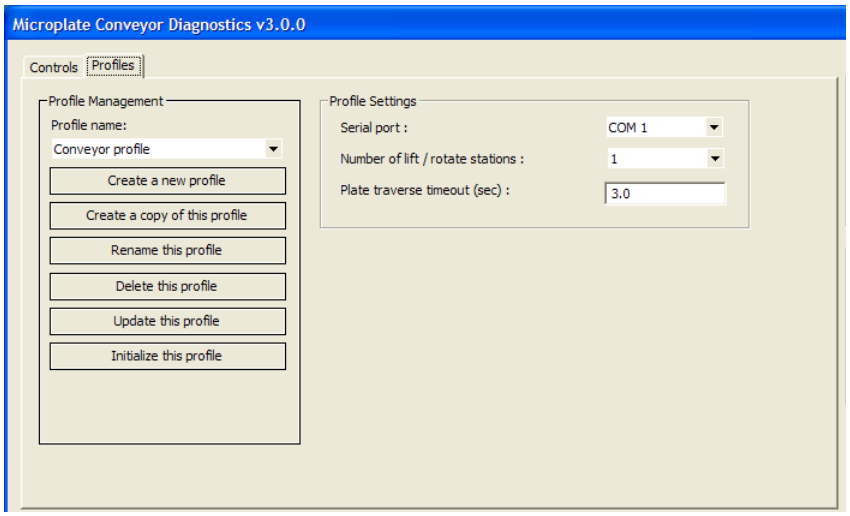
3 Select **File > Save.**

Creating a profile for the Microplate Conveyor

The Microplate Conveyor profile allows you to set up communication between the translator and the controlling computer. You can also specify other parameters, such as the number of plate stages (stations) and the traverse time before timeout error is displayed.

To create a profile:

1 In the VWorks software, open **Microplate Conveyor Diagnostics.**

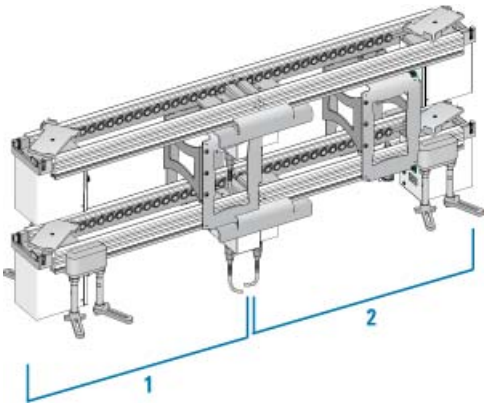


2 Click the **Profiles** tab.

3 Click **Create a new profile.** The Create Profile dialog box opens.

4 Type a name for the new profile, and then click **OK.** The new profile name appears in the Profile Management area.

5 In the **Profile settings** area, set the following parameters:

Selection or parameter	Description
Serial port	Select the serial port that connects the Microplate Conveyor to the controlling computer.
Number of lift/rotate stations	Select the number of plate stages present on the conveyor.
Plate traverse timeout (sec)	Type the length of time, in seconds, the microplates are allowed to travel the length of the conveyor before a timeout error message is displayed. For each segment of the conveyor, allow at least 3 seconds. In the following example, the conveyor has two segments. 

6 When you are finished, click **Update this profile** to save the changes.

7 Click **Initialize this profile.**

Setting teachpoints for the Microplate Conveyor

To set the teachpoints for the conveyor, you need to:

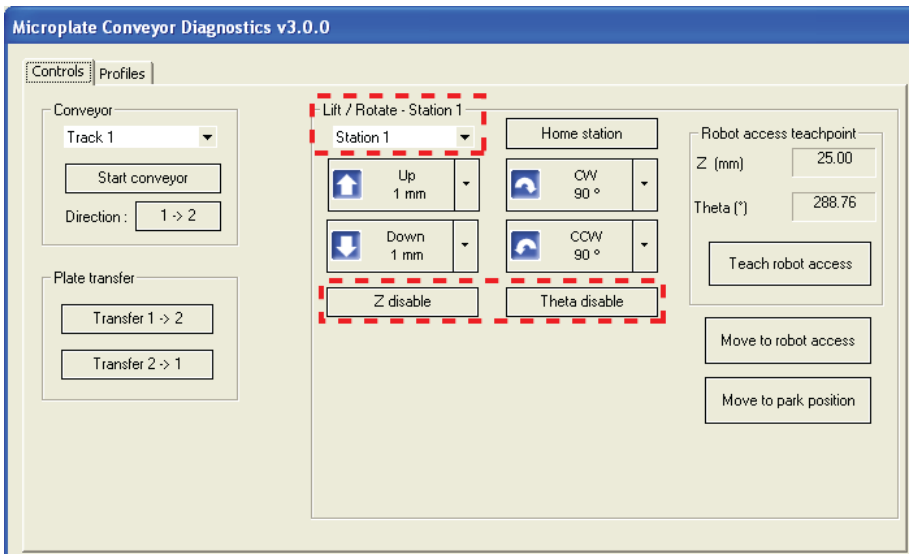
- Use Microplate Conveyor Diagnostics to set a teachpoint at each conveyor plate stage. The Station 1 teachpoint will be accessed by the BioCel System robot. If Station 2 is used, its teachpoint will be accessed by a second BioCel System robot or a third-party device.
- Use the instructions in one of the following topics to set a BioCel System robot teachpoint at Station 1, and, if applicable, Station 2.
  - "Setting Direct Drive Robot teachpoints" on page 69
  - "Setting 3-Axis Robot teachpoints" on page 117
  - "Setting KiNEDx Robot teachpoints" on page 135

  Make sure you turn off the conveyor motors before you start. To turn off the motors, see "Turning on and turning off the plate stage motors" on page 295.
- If applicable, follow instructions in the third-party user documentation to set a teachpoint at Station 2.

  Make sure you turn off the conveyor motors before you start. To turn off the motors, see "Turning on and turning off the plate stage motors" on page 295.

To set the teachpoints using Microplate Conveyor Diagnostics:

1. In **Microplate Conveyor Diagnostics,** click the **Controls** tab.
2. In the **Lift/Rotate** area, select **Station 1,** and then click **Z Disable** and **Theta Disable.** The Station-1 Z and Theta motors are turned off. You should be able to rotate and move the Station-1 plate stage up and down by hand without resistance from the motors.



3 Manually move the BioCel System robot to the Station-1 plate stage. Use the instructions in one of the following topics to set and edit the BioCel System robot teachpoint at Station 1.

- "Setting Direct Drive Robot teachpoints" on page 69
- "Setting 3-Axis Robot teachpoints" on page 117
- "Setting KiNEDx Robot teachpoints" on page 135

Note: As you are setting the robot teachpoint, you might need to adjust the position of the conveyor plate stage so that the robot can access it correctly.

4 In **Microplate Conveyor Diagnostics,** in the **Robot access teachpoint** area, click **Teach robot access.**

5 In the **Lift/Rotate** area, click **Z Enable** and **Theta Enable** to turn on the Station-1 motors.

6 If Station 2 will be accessed by a different BioCel System robot, repeat steps 2 through 5 for Station 2.

7 In the **Profiles** tab, click **Update this profile** to save the changes.

Verifying conveyor teachpoints

To verify the conveyor teachpoints:

1 Place a microplate on the Station-1 plate stage.

2 In **Microplate Conveyor Diagnostics:**

a Click **Transfer 1 -> 2** in the **Plate transfer** area. The conveyor moves the microplate from Station 1 to Station 2.

b Click **Transfer 2 -> 1** in the **Plate transfer** area. The conveyor moves the microplate from Station 2 to Station 1.

Check that the conveyor moved the microplate successfully. If necessary, edit the teachpoints.

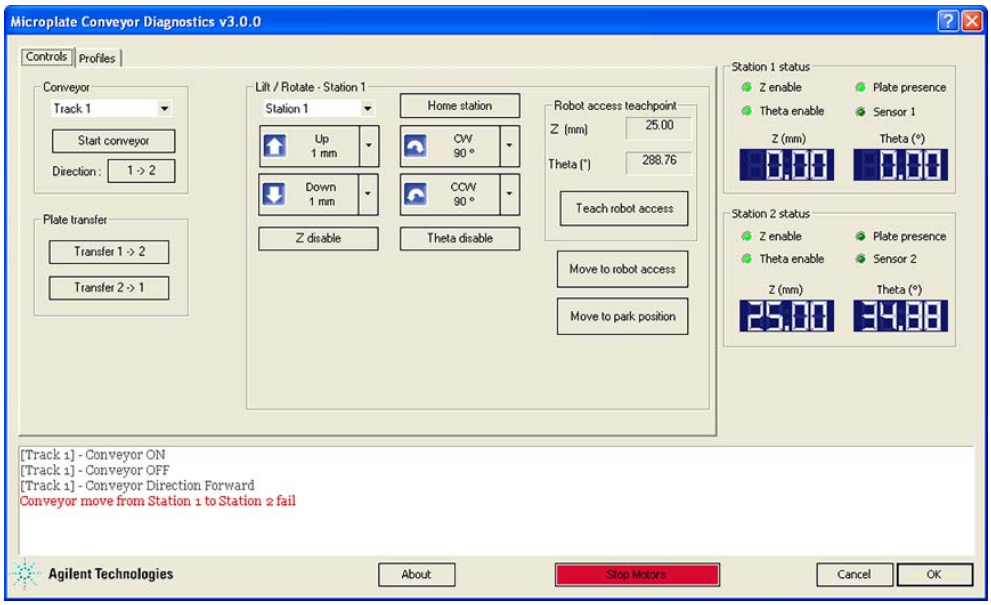
3 For the BioCel System robot, use the instructions in one of the following sections to verify and edit the teachpoint:

- "Verifying Direct Drive Robot teachpoints" on page 90
- "Verifying 3-Axis Robot teachpoints" on page 124
- "Verifying KiNEDx Robot teachpoints and waypoints" on page 143

4 For the third-party device or robot, follow the device user documentation to verify and edit the teachpoint.

Using Microplate Conveyor Diagnostics

You can use the commands and parameters in the Microplate Conveyor Diagnostics Controls tab to move individual components for troubleshooting purposes.



This section explains the following:

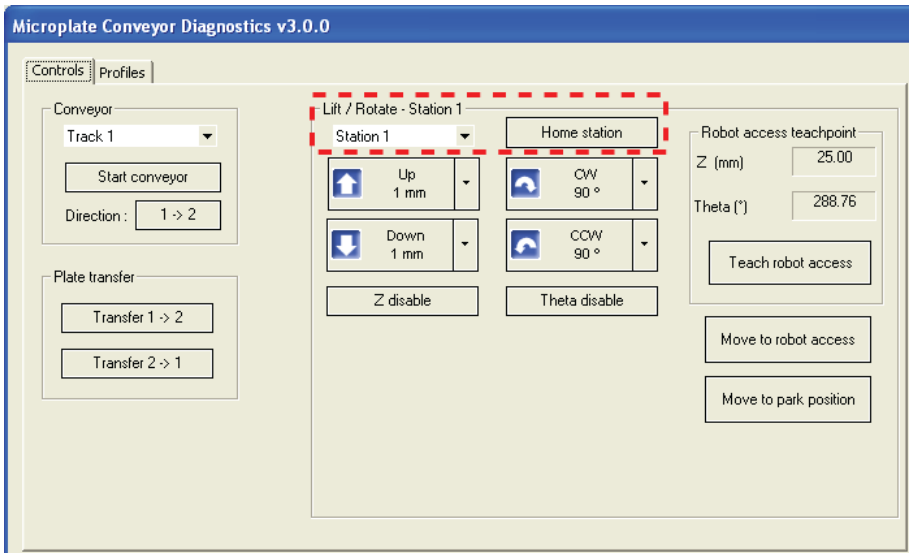
- "Homing the plate stage" on page 295
- "Turning on and turning off the plate stage motors" on page 295
- "Moving and rotating the plate stage" on page 296
- "Moving the plate stage to the conveyor teachpoint" on page 297
- "Parking the plate stage" on page 298
- "Moving the conveyor rollers" on page 298
- "Checking the microplate sensor" on page 299

Homing the plate stage

Homing sends the plate stage to the factory-defined home position for each axis of motion. You should home the plate stage when recovering from an emergency stop.

To home the plate stage:

1 In **Microplate Conveyor Diagnostics Controls** tab, select the plate stage you want to home: **Station 1** or **Station 2.**



2 Click **Home station.** The plate stage moves to its home position.

Turning on and turning off the plate stage motors

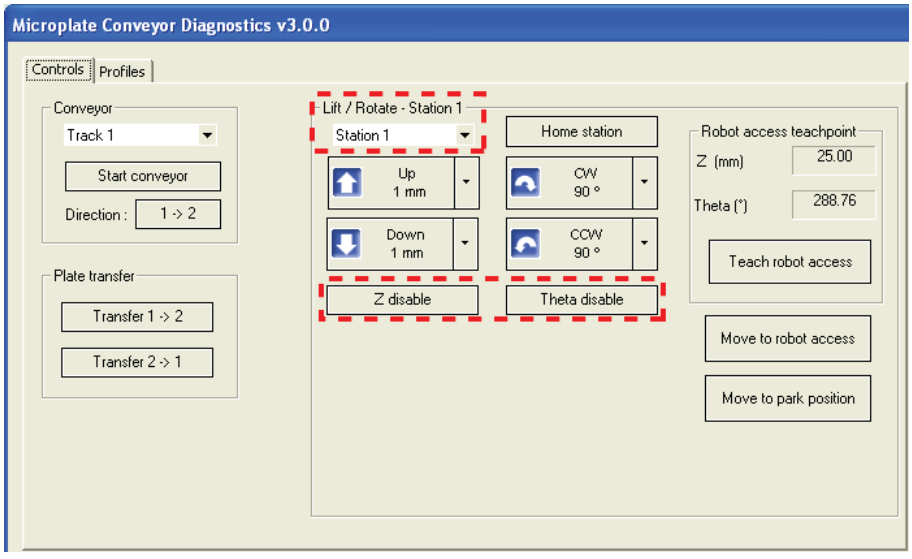
Turning off the plate stage motors allows you to move the plate stage by hand, making it easier to set and edit teachpoints. You must turn on the motors for operation.

To turn on or turn off the plate stage motors:

1 In the **Lift/Rotate** area, select the plate stage you want to work with: **Station 1** or **Station 2.**

2 Click one of the following:

Command	Description
Z Disable/Enable	Turns on or turns off the Z motor. The Z motor moves the plate stage up or down.
Theta Disable/Enable	Turns on or turns off the Theta motor. The Theta motor rotates the plate stage.



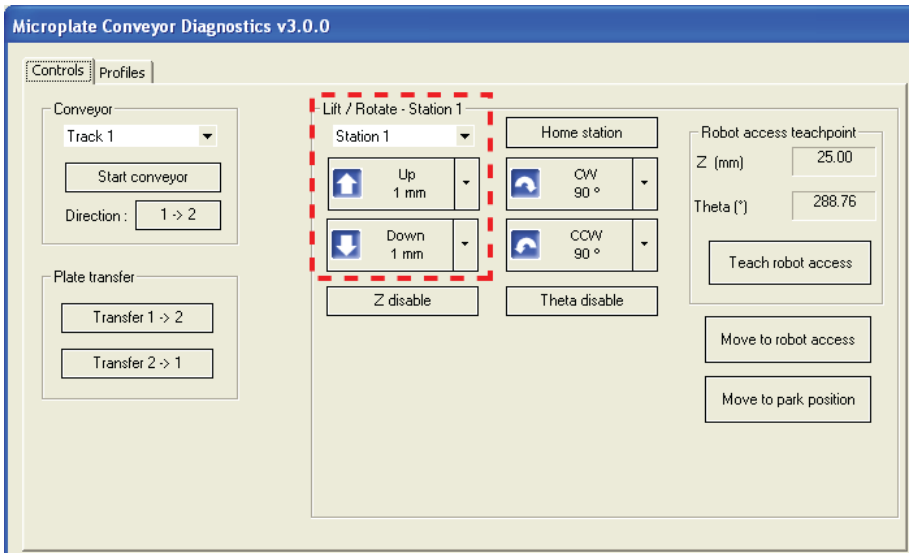
Moving and rotating the plate stage

You can move the plate stage up and down along the *z*-axis, or rotate the plate stage a specific number of degrees when setting teachpoints or diagnosing problems.

To move the plate stage incrementally along the z-axis:

1 In the **Lift/Rotate** area, select the plate stage you want to work with: **Station 1** or **Station 2.**

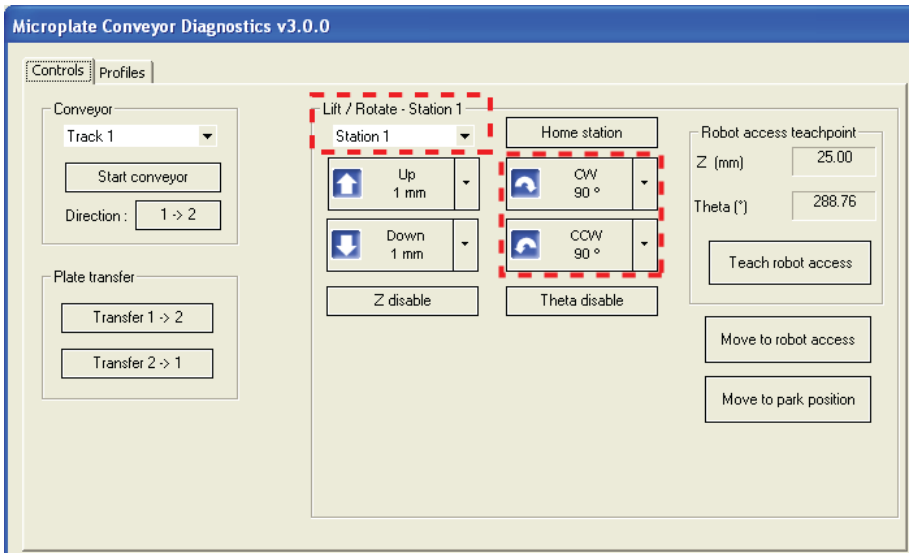
2 Select the distance you want to move the plate stage from the **Up** or **Down** list.



To rotate the plate stage:

1 In the **Lift/Rotate** area, select the plate stage you want to work with: **Station 1** or **Station 2.**

2 Select the number of degrees you want to rotate the plate stage from the **CW** (clockwise) or **CCW** (counterclockwise) list.



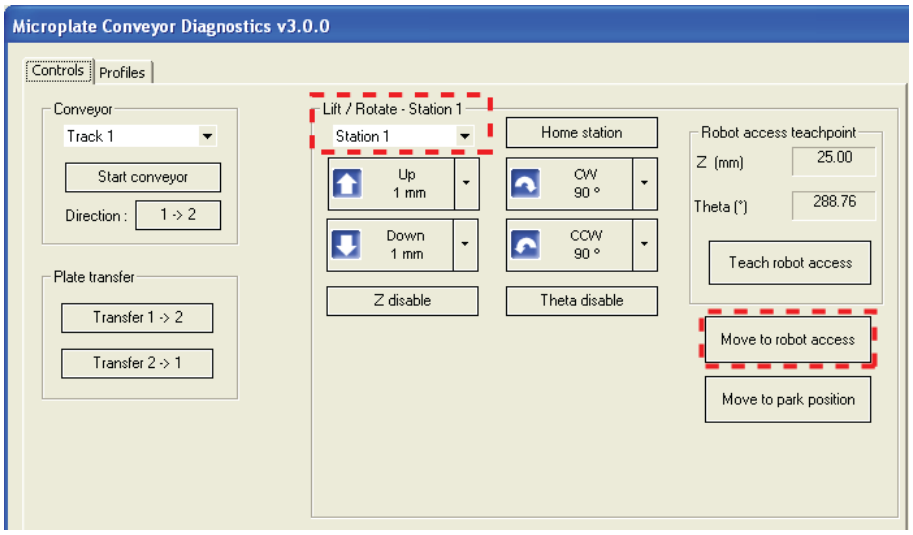
Moving the plate stage to the conveyor teachpoint

You can move the plate stage to the robot access position. The robot access position is also the conveyor teachpoint.

To move the plate stage to the teachpoint:

1 In the **Lift/Rotate** area, select the plate stage you want to work with: **Station 1** or **Station 2.**

2 Click **Move to robot access.**



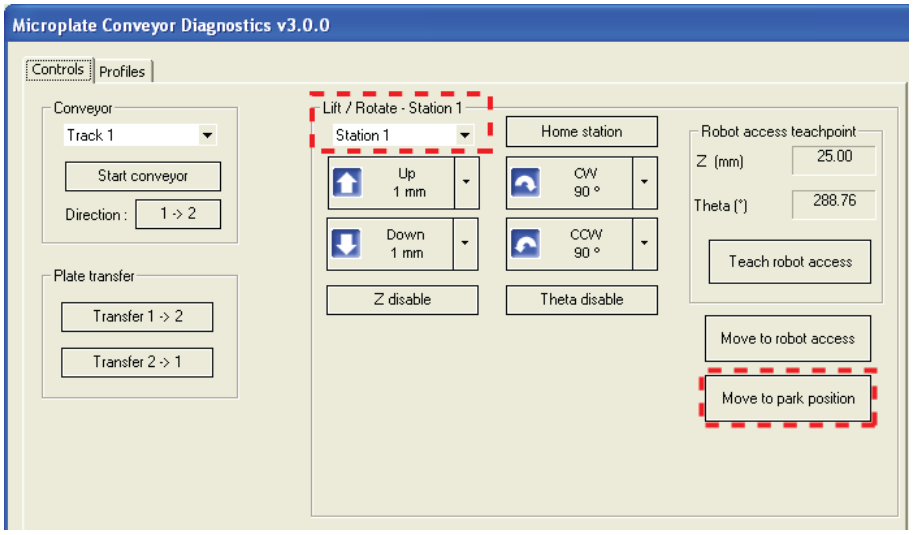
Parking the plate stage

The park position is the position at which the plate stage is recessed at one end of the conveyor. Move the plate stage to the park position when you want the plate stage out of the way while you troubleshoot other parts of the conveyor or system.

To park the plate stage:

1 In the **Lift/Rotate** area, select the plate stage you want to work with: **Station 1** or **Station 2.**

2 Click **Move to park position.**

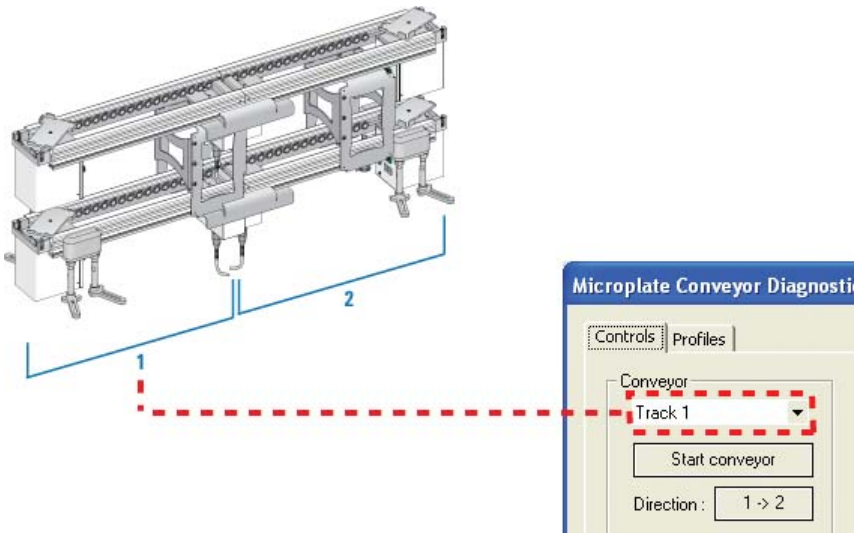


Moving the conveyor rollers

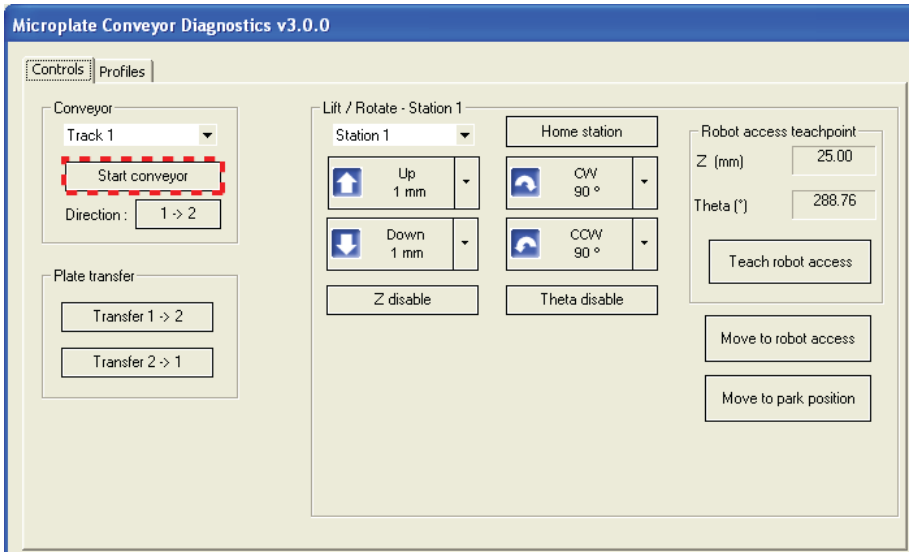
You can move the conveyor rollers in either direction to check that the motors are working.

To move the conveyor rollers:

1 *Multi-track conveyor only.* In the **Conveyor** area, select the track you want to check. **Track 1** or **Track 2.** Track 1 is the set of rollers closest to Station 1. Track 2 is the set of rollers closest to Station 2.



2 Click **Start conveyor.** The conveyor rollers start to move in one direction.



3 To change the direction of the rolling movement, click the **Direction** button: **1 -> 2** or **2 -> 1.**

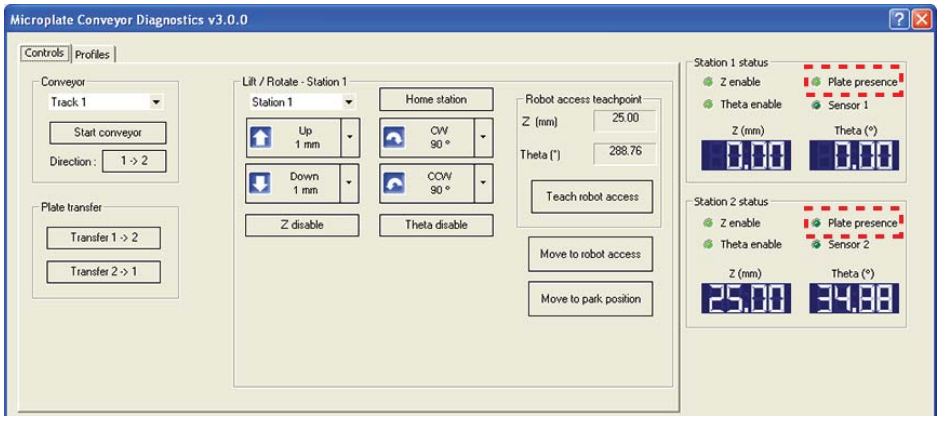
Checking the microplate sensor

The microplate sensor at the plate-stage end of the conveyor is used to detect the presence of labware at the plate stage. You can check the sensor to see if it is working correctly.

To check the microplate sensor:

1 Place a microplate on the conveyor plate stage.

2 In the **Station 1 Status** or **Station 2 status** area, check the **Plate presence** indicator light.



If the indicator light is on, the microplate sensor is detecting a labware on the plate stage. If the indicator light is off, the microplate sensor is not detecting labware. Contact Automation Solutions Technical Support to repair or replace the sensor.

Note: The **Sensor 1** and **Sensor 2** indicator lights are not used.

Related information

For information about...	See...
Using the Microplate Conveyor in a protocol	*VWorks Automation Control User Guide*
Incubator device	Incubator device driver guide
Available devices	"BioCel System additional devices overview" on page 242

Microplate Shuttle and Rotator

About this topic

This topic describes the Shuttle and Rotator, explains their uses, and provides the configuration instructions.

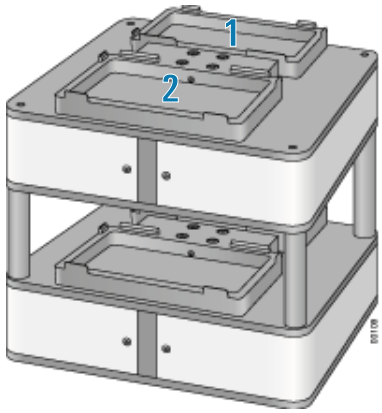
Descriptions

Shuttle

A Shuttle has two decks, each with a rotating plate stage containing a pair of platepads. The Shuttle allows two BioCel System robots to pass microplates to each other concurrently:

1. The BioCel System robot places a microplate on a platepad (1 or 2).
2. The Shuttle turns the platepad pair 180°.
3. The adjacent BioCel System robot picks up the microplate on the platepad (2 or 1).

Note: The microplates that are passed between robots maintain the same orientation.



Rotator

A Rotator has a single deck with a rotating plate stage containing a single platepad. The Rotator is used to change the orientation of microplates before the microplates are placed in devices that require the rotated orientation:

1. The BioCel System robot places a microplate on a Rotator platepad.
2. The Rotator turns the platepad 180°.
3. The BioCel System robot picks up the rotated microplate from the Rotator platepad.
4. The BioCel System robot places the rotated microplate in the device that requires that orientation.

Setup workflow

Step	Procedure	See...
1	Install the Shuttle or Rotator.	Automation Solutions Technical Support
2	Add the Shuttle or Rotator in the device file.	"Adding the microplate Shuttle or Rotator in the device file" on page 302
3	Create a profile for the Shuttle or Rotator.	"Creating a profile for the Shuttle or Rotator" on page 306
4	Set the teachpoints for the Shuttle or Rotator.	"Setting teachpoints for the Shuttle or Rotator" on page 307

Adding the microplate Shuttle or Rotator in the device file

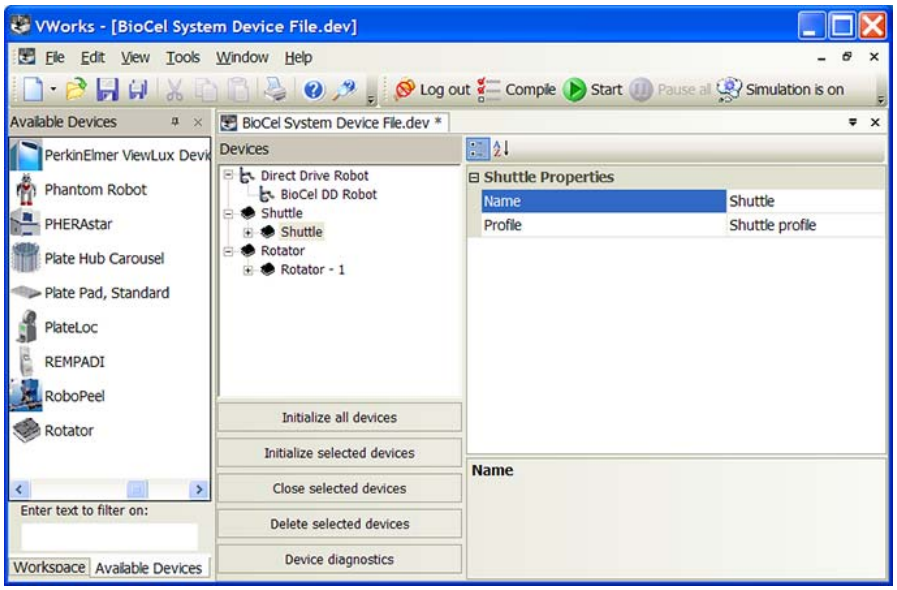
The VWorks software is set up with the correct device configuration to communicate with the microplate Shuttle or Rotator. You do not need to add it to the device file unless you want to use a different teachpoint file. For information about device files, see "Devices and device file defined" on page 39.

Adding the Shuttle or the Rotator to the device file

The software views each Shuttle deck as an independent device with two platepads. Therefore, when adding a Shuttle to the device file, you need to add two individual decks as devices. In addition, for each deck in the device file, you need to add two platepads.

To add a Shuttle to the device file:

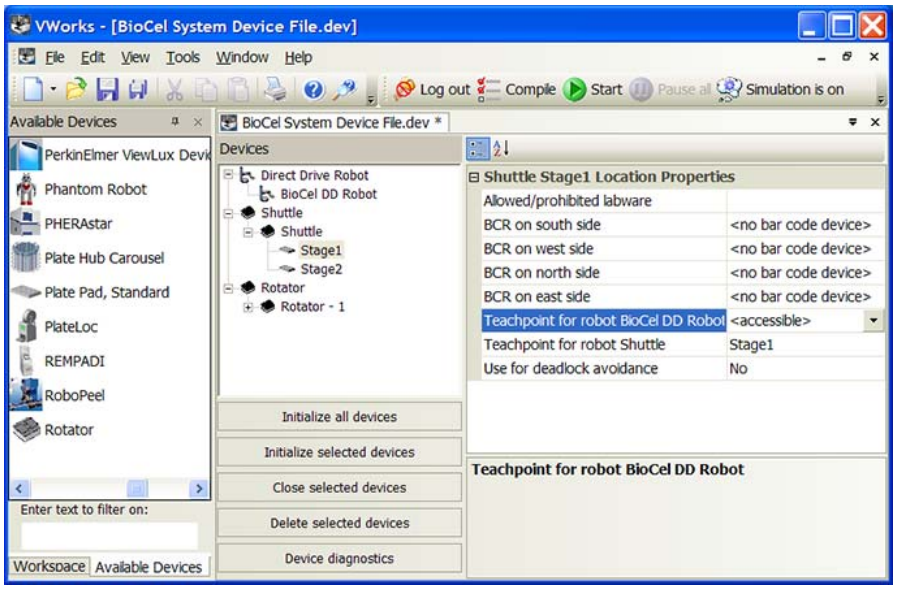
1. In the VWorks software, open the device file and add the Shuttle or the Rotator. See "Adding and deleting devices in the software" on page 39 for instructions.
2. In the **Shuttle Properties** or the **Rotator Properties** area, type or select the following:



Property	Description
Name	The name of the Shuttle or Rotator device.
Profile	The profile associated with the device. Select the desired profile from the list. If you have not created a profile, see "Creating a profile for the Shuttle or Rotator" on page 306, and then return to this step to select the profile.

3 In the **Devices** area, expand Shuttle or Rotator, and then select the stage that will interact with the BioCel System robot.

4 In the **Shuttle Properties** or the **Rotator Properties** area, set up the stage that will interact with the BioCel System robot:

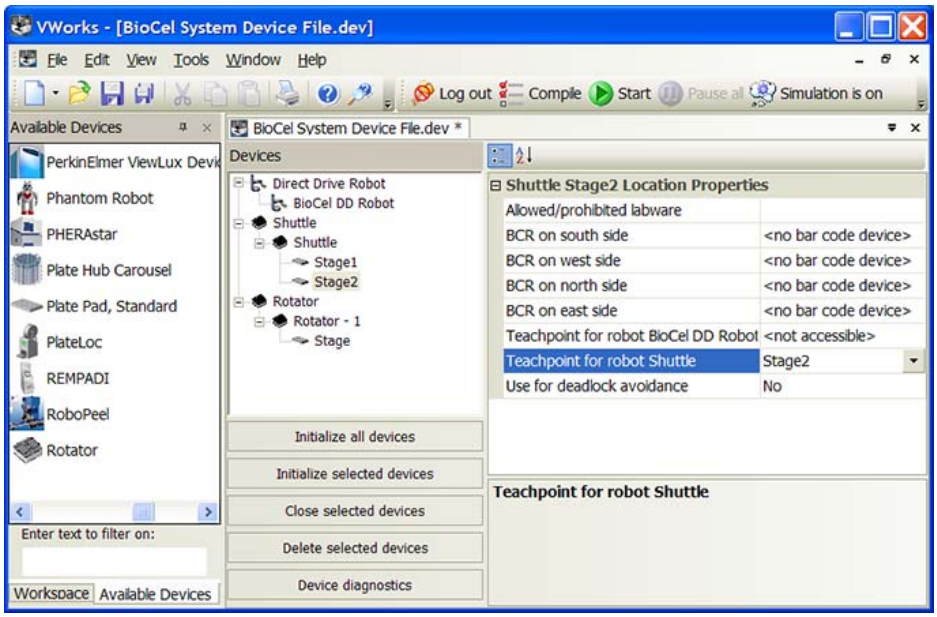


Property	Description
Allowed/prohibited labware	Permitted labware class for the selected location. For example, you might specify that only tipboxes are allowed at a given location. For details on labware classes, see the *VWorks Automation Control Setup Guide*.
BCR on south/west/north/ east side	The location of the barcode reader and the desired barcode reader device. Use these fields only if a barcode reader is installed on this device.
Teachpoint for robot <BioCel System Robot>	The name of the teachpoint for the Stage 1 or Stage 2 location. This selection enables the BioCel System robot to move correctly to and from the location during a protocol run. For example, if the robot teachpoint file contains a teachpoint for this location, you must select that teachpoint. *Note:* In simulation mode, select **<accessible>.**
Shuttle only. Teachpoint for robot <Shuttle>	The teachpoint that is set up for the Shuttle. Select **Stage 1.** For setup instructions, see "Setting teachpoints for the Shuttle or Rotator" on page 307.
Use for deadlock avoidance	Option to permit the location to be used for deadlock avoidance. Select **Yes** to permit labware to be moved to this location to avoid a deadlock in the system. Select **No** if you do not want to move random labware to this location to avoid deadlock.

5 *Shuttle only.* In the **Devices** area:

a Select **Stage 2** under Shuttle.

b In the **Shuttle Properties** area, type or set the following parameters:



Property	Description
Allowed/prohibited labware	Permitted labware class for the selected location. For example, you might specify that only tipboxes are allowed at a given location. For details on labware classes, see the *VWorks Automation Control Setup Guide*.
BCR on south/west/north/east side	The location of the barcode reader and the desired barcode reader device. Use these fields only if a barcode reader is installed on this device.
Teachpoint for robot <BioCel System Robot>	The name of the teachpoint for the stage location. Because the Stage 2 location will not interact with the robot, select **<not accessible>.**
Teachpoint for robot <Shuttle>	The teachpoint that is set up for the Shuttle. Select **Stage 2.** For setup instructions, see "Setting teachpoints for the Shuttle or Rotator" on page 307.
Use for deadlock avoidance	Option to permit the location to be used for deadlock avoidance. Select **Yes** to permit labware to be moved to this location to avoid a deadlock in the system. Select **No** if you do not want to move random labware to this location to avoid deadlock.

6 Select **File > Save.**

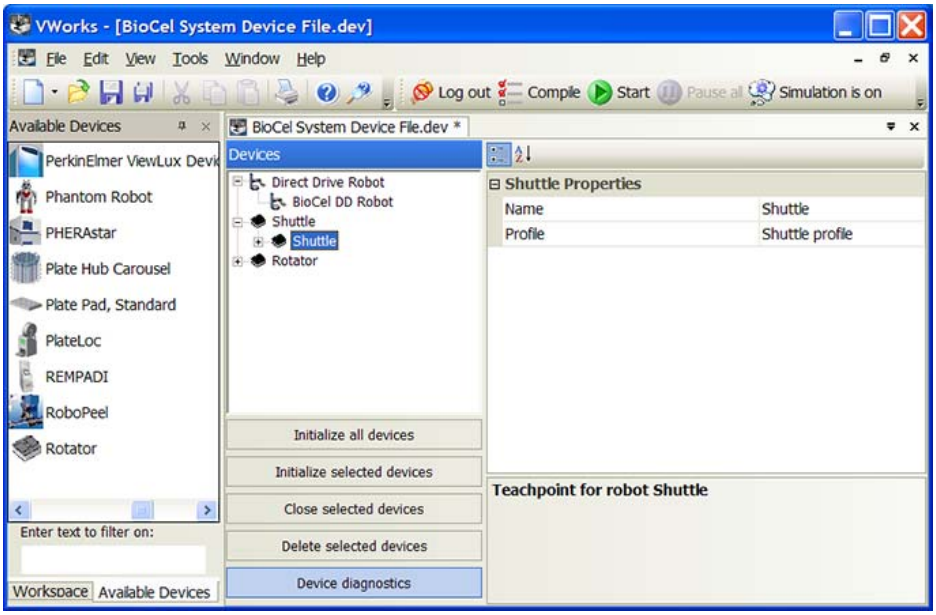
Creating a profile for the Shuttle or Rotator

The profile allows you to set up communication between the Shuttle or Rotator and the controlling computer.

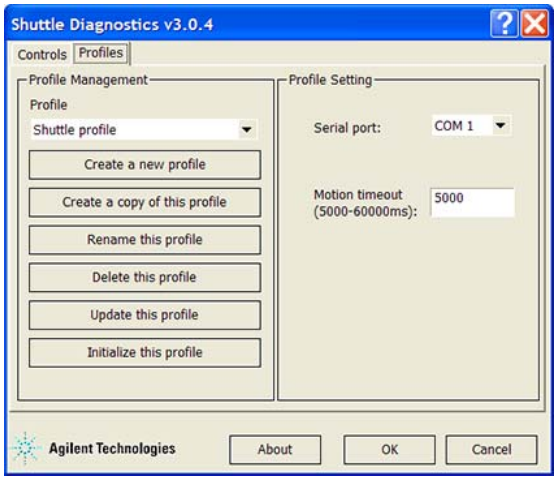
Note: The Shuttle Diagnostics and the Rotator Diagnostics are identical. Therefore, the instructions in this section are applicable to both diagnostics software.

To create a profile:

1 In the VWorks software, open **Shuttle Diagnostics** or **Rotator Diagnostics.**



The Shuttle Diagnostics or Rotator Diagnostics dialog box opens.



2 Click the **Profiles** tab.

3 Click **Create a new profile.** The New Profile dialog box opens.

4 Type a name for the new profile, and then click **OK.** The new profile name appears in the Profile Control area.

5 In the **Profile Setting** area:

- In the **Serial port** list, select the serial port that connects the Shuttle or Rotator to the controlling computer.
- In the **Motion timeout** box, type the length of time, in milliseconds, the Shuttle or the Rotator will wait for a response before timing out.

  You adjust the timeout according to the rotation speed. For example, if you adjusted the air pressure so that the rotation speed is slower, you should increase the timeout value.

6 Click **Update this profile** to save the changes.

7 Click **Initialize this profile** to establish communication with the Shuttle or Rotator.

8 Return to the device file and select the profile for the Shuttle or Rotator device.

Setting teachpoints for the Shuttle or Rotator

To set teachpoints for the microplate rotators, see one of the following:

- "Setting Direct Drive Robot teachpoints" on page 69
- "Setting 3-Axis Robot teachpoints" on page 117
- "Setting KiNEDx Robot teachpoints" on page 135

When you set the Shuttle or Rotator teachpoints:

1 Teach both system robots simultaneously.

2 Make sure both robots are aligned perfectly with the Shuttle or Rotator. You might have to move the Shuttle or Rotator slightly to a position that allows the system robots to align perfectly.

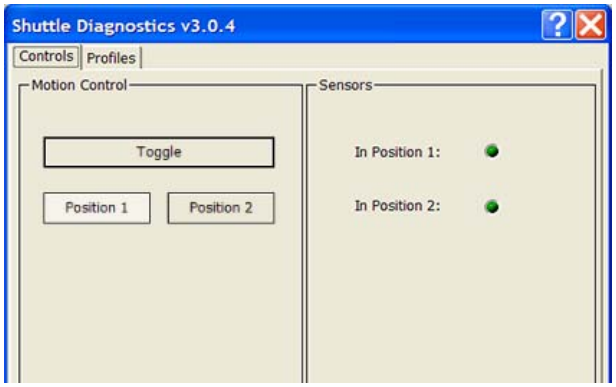
Using Diagnostics

You can use the commands and parameters in the Diagnostics to rotate the plate stage pair on one of the decks.

Note: The Shuttle Diagnostics and the Rotator Diagnostics are identical. Therefore, the instructions in this section are applicable to both diagnostics software.

To turn the plate stage on a deck:

1 In **Shuttle Diagnostics** or **Rotator Diagnostics,** click the **Controls** tab.



2 In the **Motion Control** area, click one of the following:

Button	Description
Toggle	Alternately rotates the plate stage 180° clockwise or counterclockwise. For example, if clicking Toggle rotates the plate stage clockwise, the next click will rotate the plate stage counterclockwise.
Position 1	Rotates the plate stage 180° clockwise. The Position 1 button is only active after you have clicked Position 2.
Position 2	Rotates the plate stage 180° counterclockwise. The Position 2 button is only active after you have clicked Position 1.

In the **Sensors** area, the indicator light shows:

Indicator light	Description
Position 1	The Position 1 button is active.
Position 2	The Position 2 button is active.

Related information

For information about...	See...
Using the Shuttle or Rotator in a protocol	*VWorks Automation Control User Guide*
Linear Translator	"Linear Translator" on page 272
Available devices	"BioCel System additional devices overview" on page 242

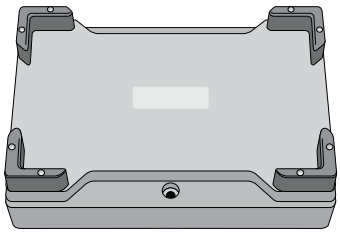
Orbital Shaking Station

About this topic

This topic describes the Orbital Shaking Station, explains its use, and provides the configuration instructions.

Description

An Orbital Shaking Station is a microplate shaker that can be installed in place of a platepad on the BioCel System table. For a full description of the Orbital Shaking Station, see the manufacturer's documentation.



Setup workflow

Step	Procedure	See...
1	Install the Orbital Shaking Station.	Automation Solutions Technical Support
2	Add the Orbital Shaking Station in the device file.	"Adding the Orbital Shaking Station in the device file" on page 310
3	Create a profile for the Orbital Shaking Station.	"Creating a profile for the Orbital Shaking Station" on page 312
4	Set, edit, and verify the teachpoint for the Orbital Shaking Station.	One of the following: • "Setting Direct Drive Robot teachpoints" on page 69 • "Setting 3-Axis Robot teachpoints" on page 117 • "Setting KiNEDx Robot teachpoints" on page 135

Adding the Orbital Shaking Station in the device file

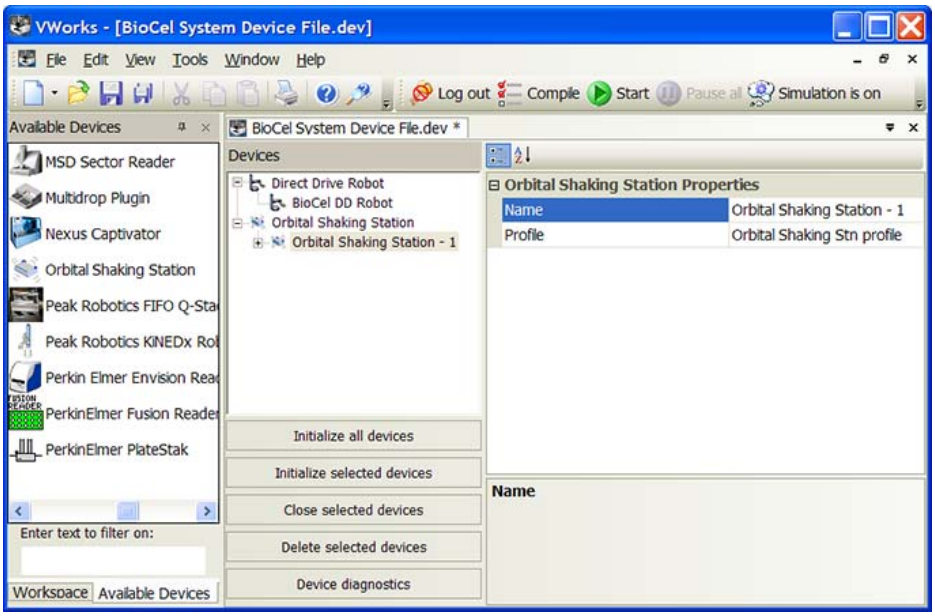
The VWorks software is set up with the correct device configuration to communicate with the Orbital Shaking Station. You do not need to add a new Orbital Shaking Station to the device file unless you want to use a different teachpoint file. For information about device files, see "Devices and device file defined" on page 39.

Before you start, make sure that at the Orbital Shaking Station speed control (on the power cord), the speed dial is set to PC RS232. This setting allows the VWorks software to control the Orbital Shaking Station.

To add the Orbital Shaking Station to the device file:

1 In the VWorks software, open the device file and add the Teleshake (Orbital Shaking Station) device. See "Adding and deleting devices in the software" on page 39 for instructions.

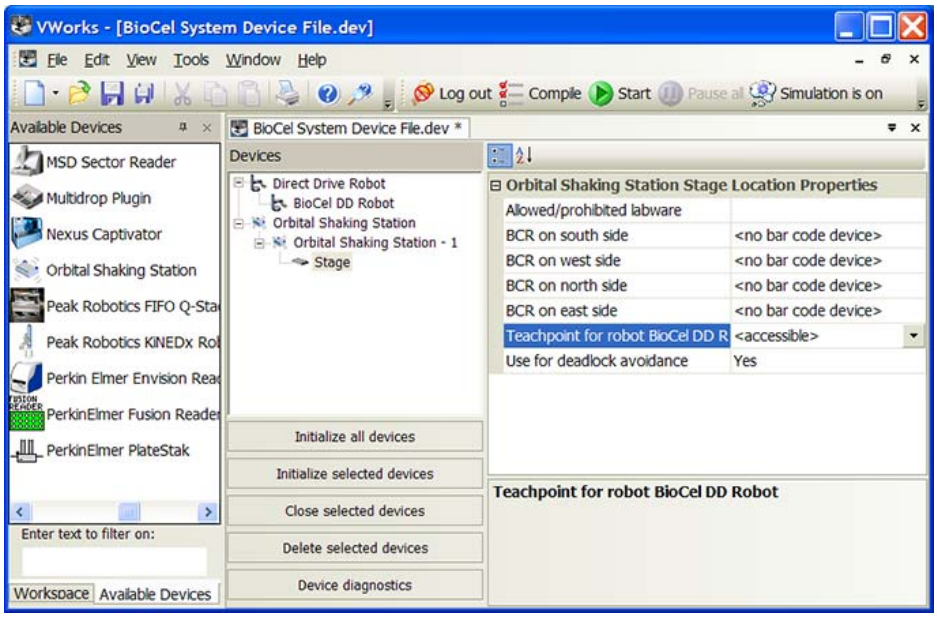
2 In the **Orbital Shaking Station Properties** area, type or select the following:



Property	Description
Name	The name of the Orbital Shaking Station device.
Profile	The profile associated with the device. Select the desired profile from the list. If you have not created a profile, see "Creating a profile for the Orbital Shaking Station" on page 312, and then return to this step to select the profile.

3 In the **Devices** area, expand the **Orbital Shaking** device, and then select the **Stage** location.

4 In the **Orbital Shaking Station Stage Location Properties** area, type or set the following:



Property	Description
Allowed/prohibited labware	Permitted labware class for the selected location. For example, you might specify that only tipboxes are allowed at a given location. For details on labware classes, see the *VWorks Automation Control Setup Guide*.
BCR on south/west/north/east side	The location of the barcode reader and the desired barcode reader device. Use this field only if a barcode reader is installed on the device.
Teachpoint for robot <BioCel System Robot>	The name of the teachpoint to use for the stage location. This selection enables the robot to move correctly to and from the platepad or device during a protocol run. For example, if the robot teachpoint file contains a teachpoint for this platepad, you must select that teachpoint. *Note:* In simulation mode, select **<accessible>.**
Use for deadlock avoidance	Option to permit the location to be used for deadlock avoidance. Select **Yes** to permit labware to be moved to this location to avoid a deadlock in the system. Select **No** if you do not want to move random labware to this location to avoid deadlock.

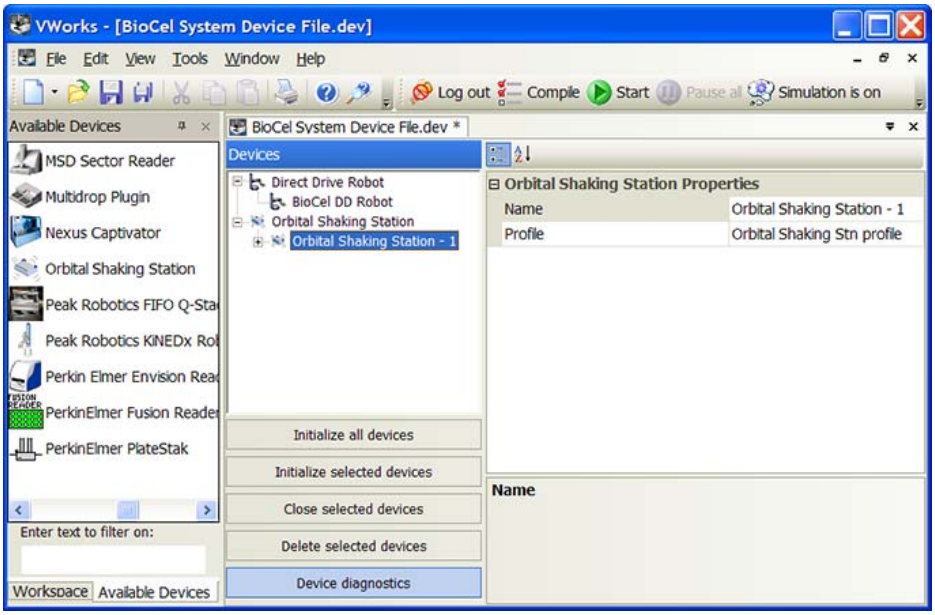
5 Select **File > Save.**

Creating a profile for the Orbital Shaking Station

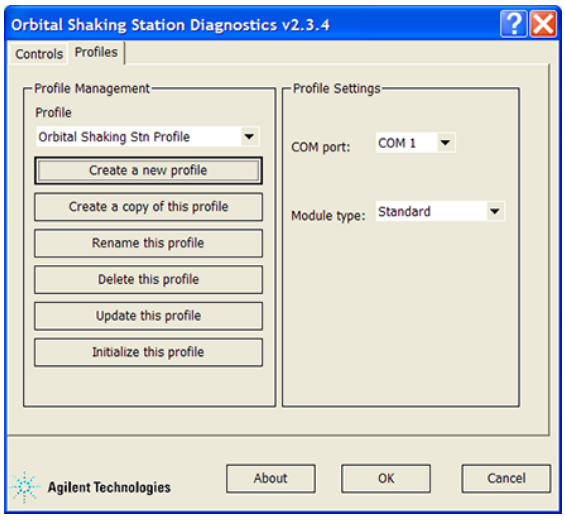
The Orbital Shaking Station profile allows you to set up communication between the Orbital Shaking Station and the controlling computer.

To create a profile:

1 In the VWorks window, select the **Orbital Shaking Station** device, and then click **Device diagnostics.**



The Orbital Shaking Station Diagnostics dialog box opens.



2 Click the **Profiles** tab.

3 Click **Create a new profile.** The Create Profile dialog box opens.

4 Type a name for the new profile, and then click **OK.** The new profile name appears in the Profile area.

5 In the **COM port** list, select the COM port number used by the Orbital Shaking Station.

6 In the **Module type** list, select the shaking speed: **Standard** or **High-speed.**

7 Click **Update this profile** to save the changes.

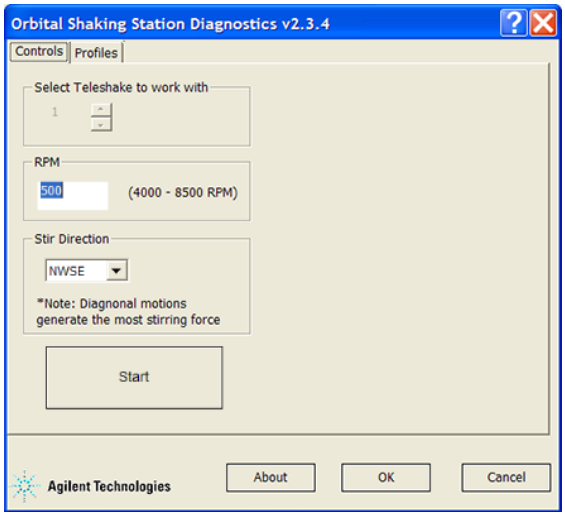
8 Click **Initialize this profile** to establish communication with the Orbital Shaking Station.

9 Return to the device file and select the profile for the Orbital Shaking Station.

Using Orbital Shaking Station Diagnostics

You can use the parameters and commands in Orbital Shaking Station Diagnostics to do the following for troubleshooting purposes:

- Set shaking parameters
- Start and stop shaking



To set the shaking parameters:

1 In the **Orbital Shaking Station Diagnostics** dialog box, click the **Controls** tab.

2 If you have more than one shaking station installed, select the one you want to use in the **Select Teleshake to work with list.**

3 In the **RPM** area, set the speed at which you want to shake the microplate.

4 In the **Stir Direction** area, select the direction in which you want to shake the microplate.

To start or stop shaking:

Click **Start** or **Stop.**

Related information

For information about...	See...
Using the Orbital Shaking Station in a protocol	*VWorks Automation Control User Guide*
Set teachpoints at the Orbital Shaking Station	One of the following: • "Setting Direct Drive Robot teachpoints" on page 69 • "Setting 3-Axis Robot teachpoints" on page 117 • "Setting KiNEDx Robot teachpoints" on page 135

Phantom Robot

About this topic

This topic describes the Phantom Robot, explains its use, and provides the configuration instructions.

Description

In the VWorks software, every task is associated with a device. The Phantom Robot is the virtual device that represents the operator who will manually perform a task (move labware) during a programmed pause in a protocol run. The software displays a message during the pause. You can indicate the completion of the task in the message dialog box so the protocol can continue.

Setup workflow

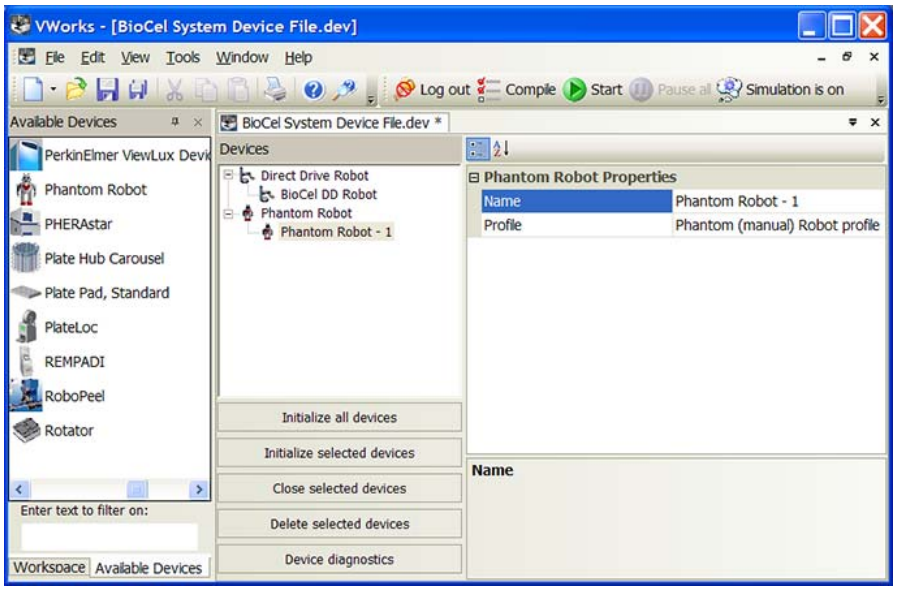
Step	Procedure	See...
1	Add the Phantom Robot in the device file.	"Adding the Phantom Robot in the device file" on page 315
2	Create a profile for the Phantom Robot.	"Creating a profile for the Phantom Robot" on page 316

Adding the Phantom Robot in the device file

The VWorks software is set up with the correct device configuration. You do not need to add a new Phantom Robot to the device file unless you want to make adjustments. For information about device files, see "Devices and device file defined" on page 39.

To add the Phantom Robot to the device file:

1. In the VWorks software, open the device file and add the Phantom Robot. See "Adding and deleting devices in the software" on page 39 for instructions.
2. In the **Phantom Robot Properties** area, type or select the following:



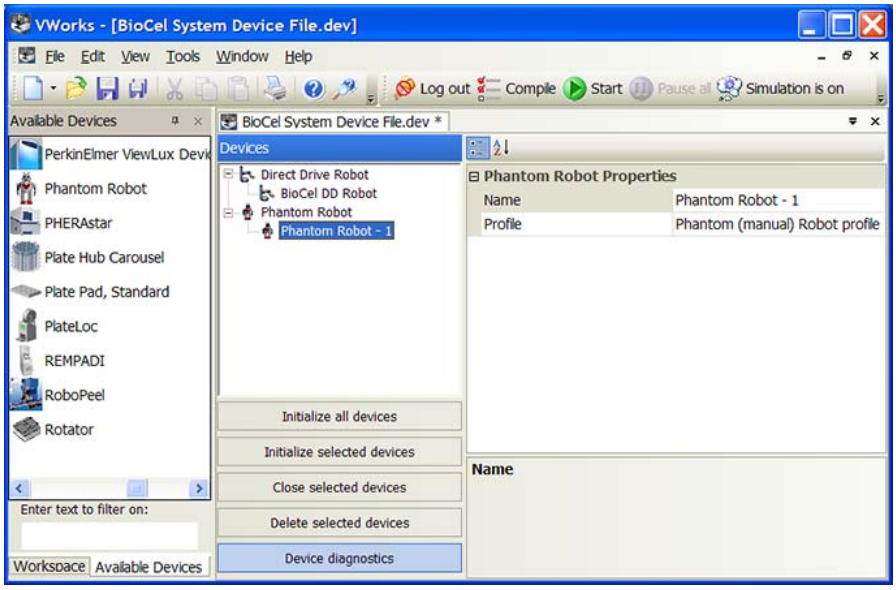
Property	Description
Name	The name of the Phantom Robot.
Profile	The profile associated with the device. Select the desired profile from the list. If you have not created a profile, see "Creating a profile for the Phantom Robot" on page 316, and then return to this step to select the profile.

3 Select **File > Save.**

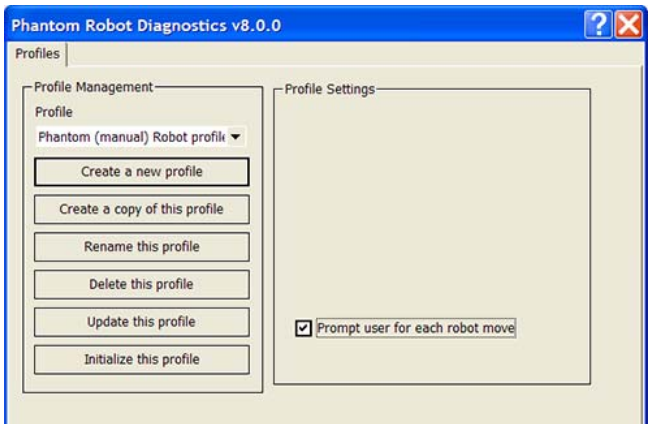
Creating a profile for the Phantom Robot

To create a profile for the Phantom Robot:

1 In the **VWorks** window, select the **Phantom Robot** device, and then click **Device diagnostics.**



The Phantom Robot Diagnostics dialog box opens.



2 In the **Profiles** tab, click **Create new profile.**

3 In the Create Profile dialog box that opens, type a name for the profile, and then click **OK.**

4 *Optional.* If you want the software to prompt the operator for each robot movement, select **Prompt user for each robot move.**

5 Click **Update this profile** to save the changes.

6 Click **Initialize this profile**.

7 Return to the device file and select the profile for the Phantom Robot device.

Related information

For information about...	See...
Mounting devices on the docking table	Automation Solutions Technical Support
Devices that can be integrated in the BioCel System	“Device integration options” on page 23
Available devices	“BioCel System additional devices overview” on page 242

Plate Hotel and Plate Hub Carousel

About this topic

This topic describes the Plate Hotel and Plate Hub Carousel, explains their uses, and provides the configuration instructions.

Description

Plate Hotel

A Plate Hotel is a vertical rack that stores microplates. The microplates sit on individual shelves and are not stacked directly on top of one another. Therefore, the microplates can be accessed randomly.

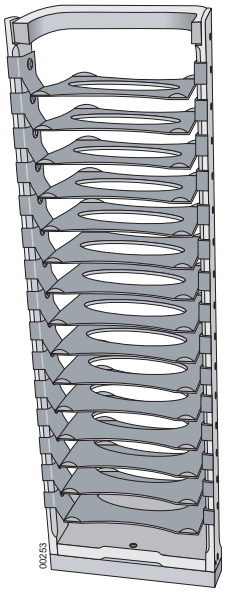


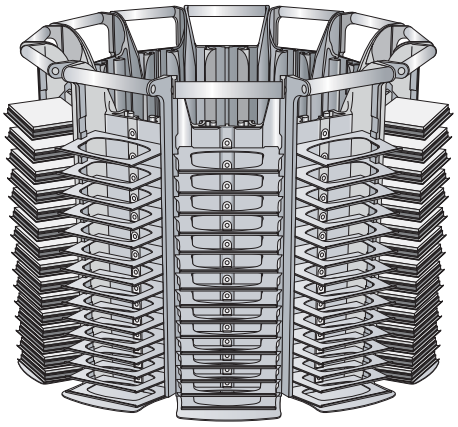
Plate Hub Carousel

Two models of the Plate Hub Carousel are available: Landscape (1) and Portrait (2). Both consists of twelve racks (cassettes) that store microplates, tipboxes, or other labware. Different rack types are available for each model:

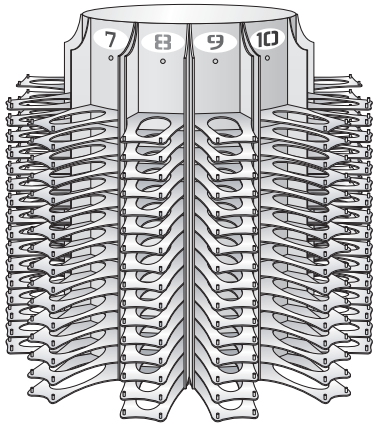
Feature and rack type	Landscape model	Portrait model
Maximum number of racks	12	12
Regular microplate rack	16 slots	16 slots
Tall labware rack	6 or 8 slots	7 slots

Note: You can use a combination of rack types in each model to meet your application requirements.

1



2



The Plate Hub Carousel must be used with the VWorks software inventory management system for random and dynamic access. For information about setting up and using the software inventory management system, see the *VWorks Automation Control Setup Guide*.

Setup workflow

The following setup workflow applies to both the Plate Hotel and the Plate Hub Carousel.

Step	Procedure	See...
1	Install the Plate Hotel or Plate Hub Carousel.	Automation Solutions Technical Support
2	Add the Plate Hub Carousel in the device file. *Note:* The VWorks software views the Plate Hotel as a single rack from the Plate Hub Carousel. Therefore, to set up a Plate Hotel, you add the Plate Hub Carousel in the device file.	"Adding the Plate Hub Carousel in the device file" on page 321
3	Create a profile for the Plate Hotel or Plate Hub Carousel.	"Creating a profile for the Plate Hotel or Plate Hub Carousel" on page 323
4	Set, edit, and verify the teachpoints for the Plate Hotel or Plate Hub Carousel.	"Setting teachpoints for the Plate Hotel or Plate Hub Carousel" on page 327

Adding the Plate Hub Carousel in the device file

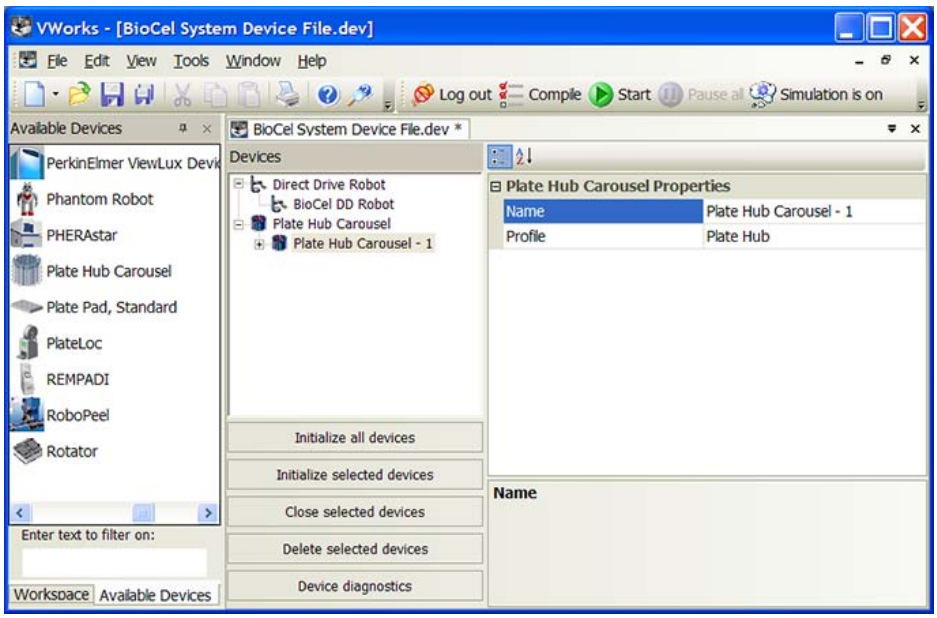
Note: The VWorks software views the Plate Hotel as a single rack from the Plate Hub Carousel. Therefore, to set up a Plate Hotel, you add the Plate Hub Carousel in the device file.

The VWorks software is set up with the correct device configuration to communicate with the Plate Hotel or Plate Hub Carousel. You do not need to add a new Plate Hub Carousel to the device file unless you want to reference different profiles or use a different teachpoint file. For information about device files, see "Devices and device file defined" on page 39.

To add the Plate Hub Carousel to the device file:

1 In the VWorks software, open the device file and add the Plate Hub Carousel. See "Adding and deleting devices in the software" on page 39 for instructions.

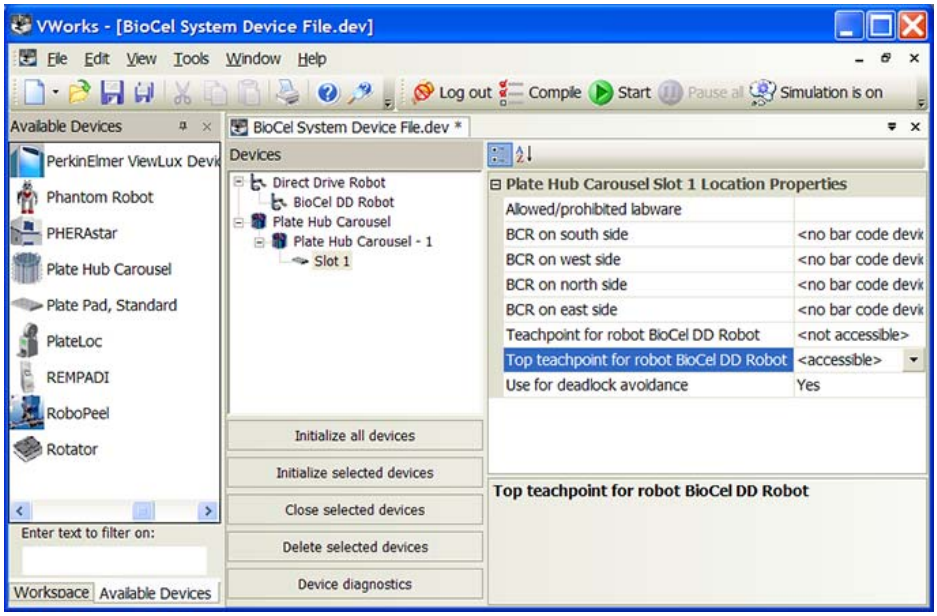
2 In the **Plate Hub Carousel Properties** area, type or select the following:



Property	Description
Name	The name of the Plate Hub Carousel device.
Profile	The profile associated with the device. Select the desired profile from the list. If you have not created a profile, see "Creating a profile for the Plate Hotel or Plate Hub Carousel" on page 323, and then return to this step to select the profile.

3 In the **Devices** area, expand **Plate Hub Carousel**, and then select **Slot 1.**

4 In the **Plate Hub Carousel Slot 1 Properties** area, type or set the following:


VWorks - [BioCel System Device File.dev]
File Edit View Tools Window Help
Log out Compile Start Pause all Simulation is on
Available Devices
PerkinElmer ViewLux Devi
Phantom Robot
PHERAstar
Plate Hub Carousel
Plate Pad, Standard
PlateLoc
REMPADI
RoboPeel
Rotator
Enter text to filter on:
Workspace Available Devices
BioCel System Device File.dev *
Devices
Direct Drive Robot
BioCel DD Robot
Plate Hub Carousel
Plate Hub Carousel - 1
Slot 1
Initialize all devices
Initialize selected devices
Close selected devices
Delete selected devices
Device diagnostics
Plate Hub Carousel Slot 1 Location Properties
Allowed/prohibited labware
BCR on south side <no bar code devi
BCR on west side <no bar code devi
BCR on north side <no bar code devi
BCR on east side <no bar code devi
Teachpoint for robot BioCel DD Robot <not accessible>
Top teachpoint for robot BioCel DD Robot <accessible>
Use for deadlock avoidance Yes
Top teachpoint for robot BioCel DD Robot

Property	Description
Allowed/prohibited labware	Permitted labware class for the selected location. For example, you might specify that only tipboxes are allowed at a given location. For details on labware classes, see the *VWorks Automation Control Setup Guide*.
BCR on south/west/north/east side	The location of the barcode reader and the desired barcode reader device. Use this field only if a barcode reader is installed on the device.
Teachpoint for robot <BioCel System Robot>	The name of the teachpoint for the Slot 1 (bottom-most slot) location. This selection enables the robot to move correctly to and from the Slot 1 location during a protocol run. For example, if the robot teachpoint file contains a teachpoint for this slot, you must select that teachpoint. *Note:* In simulation mode, select **<accessible>.**
Top teachpoint for robot <BioCel System Robot>	The name of the teachpoint for the top-most slot location. For example, if the robot teachpoint file contains a teachpoint for this slot, you must select that teachpoint. *Note:* In simulation mode, select **<accessible>.**

Property	Description
Use for deadlock avoidance	Option to permit the location to be used for deadlock avoidance. Select **Yes** to permit labware to be moved to this location to avoid a deadlock in the system. Select **No** if you do not want to move random labware to this location to avoid deadlock. **IMPORTANT** Always select **No** for the Plate Hub Carousel.

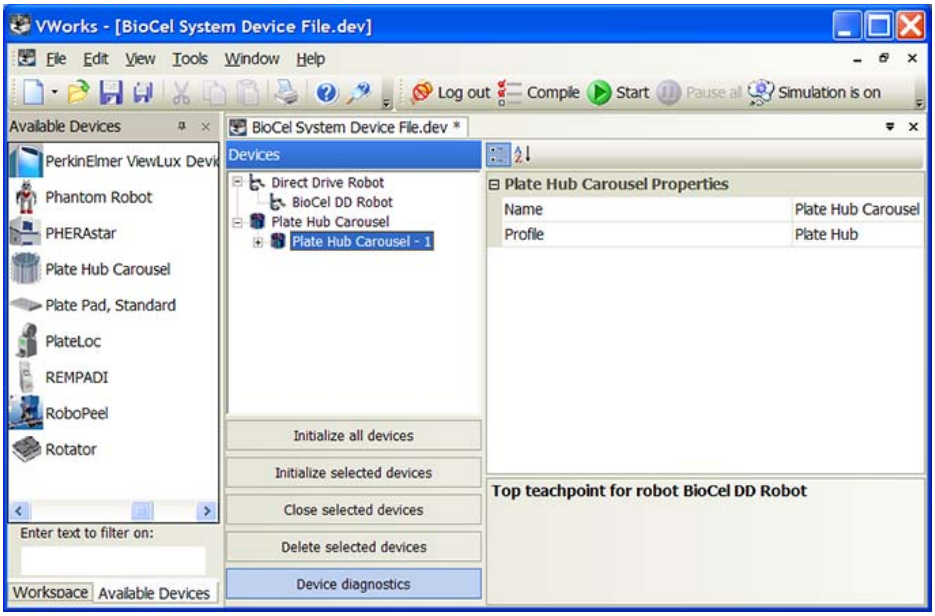
5 Select **File > Save.**

Creating a profile for the Plate Hotel or Plate Hub Carousel

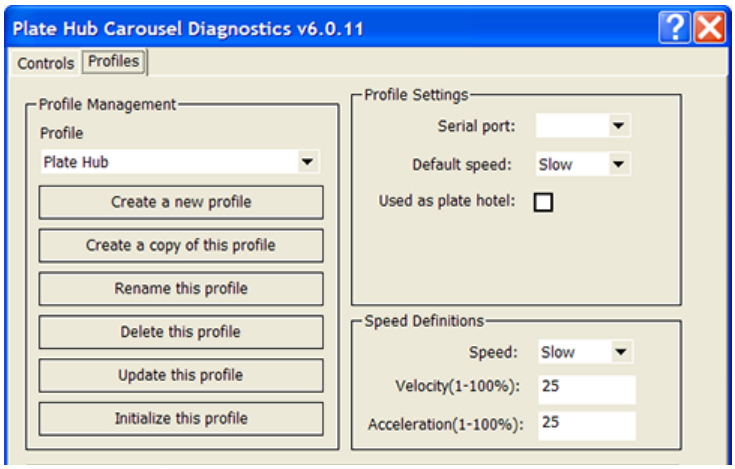
You use Plate Hub Carousel Diagnostics to create a profile for both the Plate Hotel and Plate Hub Carousel. The Plate Hub Carousel profile allows you to set up communication between the Plate Hotel or carousel and the controlling computer. You can also set the speed at which the carousel turns and indicate the number of cassettes and rack types that will be used.

To create a profile:

1 In the VWorks software, open **Plate Hub Carousel Diagnostics.**



The Plate Hub Carousel Dialog box opens.

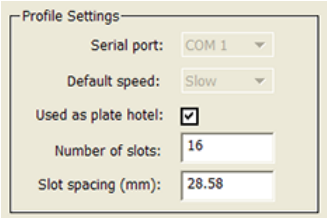


2 Click the **Profiles** tab.

3 Click **Create a new profile.** The Create Profile dialog box opens.

4 Type a name for the new profile, and then click **OK.** The new profile name appears in the Profile Management area.

5 *Plate Hotel only*. In the **Profile settings** area, select **Use as plate hotel.** Type the following values:



Parameter	Description
Number of slots	The number of slots in the Plate Hotel.
Slot spacing (mm)	The vertical distance, in millimeters, between each Plate Hotel slot.

6 *Plate Hub Carousel only*. In the **Profile settings** area:

- In the **Serial port** list, select the serial port that connects the Plate Hub Carousel to the controlling computer.
- In the **Default speed** list, select the speed at which you want the Plate Hub Carousel to turn: **Slow, Medium, or Fast.**

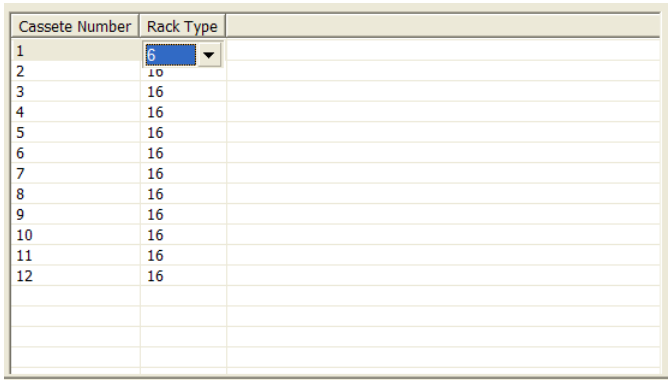
7 *Plate Hotel only*. In the **Speed Definitions** area, define the three possible speeds (High, Medium, Low) as a percentage of the factory-set maximum speed. To do this:

   a In the **Speed** list, select the speed you want to define.

   b In the **Velocity** box, type the percentage of factory-set maximum speed. For example, you can set the Slow speed at 15% of the factory-set maximum speed.

   c In the **Acceleration** box, type the percentage of maximum factory-set acceleration. For example, you can set the Slow acceleration at 15% of the factory-set maximum acceleration.

8 *Plate Hotel only*. In the **Cassette Number** table, select the type of rack to be used in each cassette: **6, 8,** or **16.** Each type is distinguished by the maximum number of slots the cassette contains.



9 When you are finished, click **Update this profile** to save the changes.

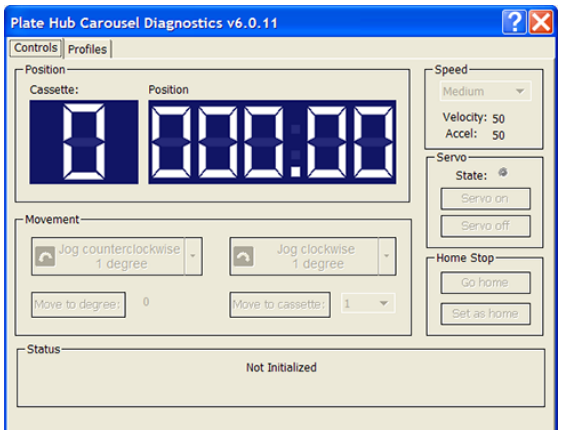
10 Click **Initialize this profile.**

11 Return to the device file and select the profile for the Plate Hub Carousel device.

Using Plate Hub Carousel Diagnostics

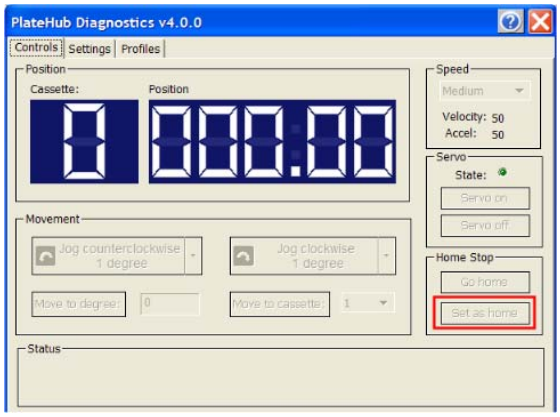
You can use the commands and parameters in the Plate Hub Carousel Diagnostics Controls tab to:

- Set the home position.
- Turn the carousel to a specific position.



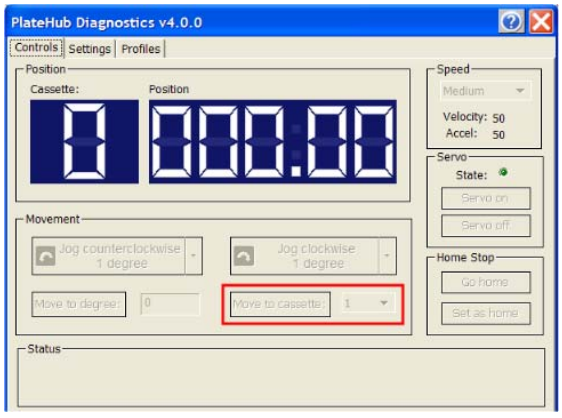
To set the home position:

1. In the **Servo** area, click **Servo off** to turn off the Plate Hub Carousel motors.
2. Manually turn the carousel so that cassette 1 lines up with the robot. You can use the teaching jig to make sure the alignment is accurate. For information about using the teaching jig, see "Setting Direct Drive Robot teachpoints" on page 69, "Setting 3-Axis Robot teachpoints" on page 117, or "Setting KiNEDx Robot teachpoints" on page 135.
3. When you are finished aligning the cassette 1 with the robot, move the robot and its grippers away from the carousel.
4. In the **Servo** area, click **Servo on** to turn on the Plate Hub Carousel motors.
5. Click **Set as home** in the **Home Stop** area.



To turn the Plate Hub Carousel:

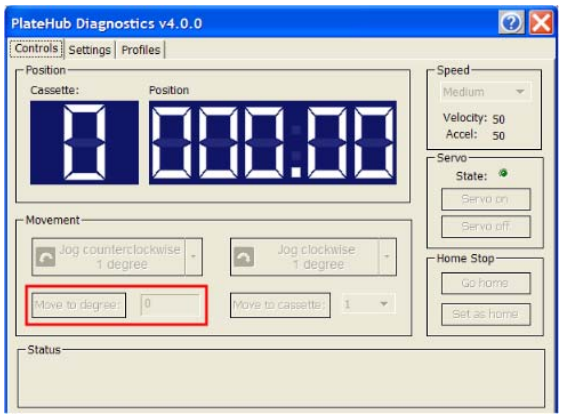
1. Move the robot away from the Plate Hub Carousel.
2. To move a cassette to the cassette-1 home position:
   a. In the **Movement** area, in the list next to the **Move to cassette** button, select the cassette number.
   b. Click **Move to cassette.** The carousel turns until the selected cassette is at the cassette-1 home position.



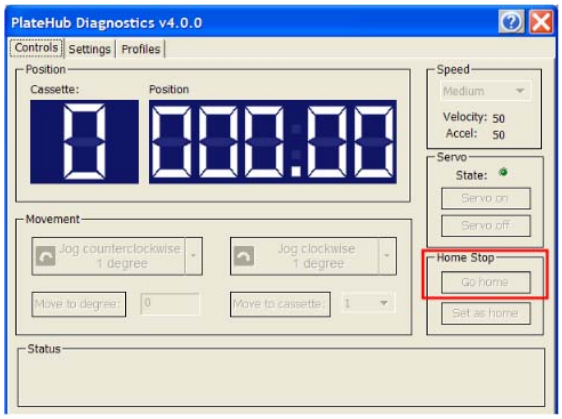
3 To turn the carousel a specified number of degrees relative to the home position:

a In the box next to the **Move to degree** button, type an angular position (0–360) in degrees.

b Click the **Move to degree** button. The carousel turns the specified number of degrees from the home position.



4 To return the carousel to its home position, in the **Home Stop** area, click **Go Home.**



Setting teachpoints for the Plate Hotel or Plate Hub Carousel

To set, edit, and verify teachpoints for the Plate Hub Carousel, see one of the following:

- “Setting Direct Drive Robot teachpoints” on page 69
- “Setting 3-Axis Robot teachpoints” on page 117
- “Setting KiNEDx Robot teachpoints” on page 135

When you set the teachpoints, use the provided teaching jig to set a teachpoint at the following locations:

- Top shelf
- Bottom shelf

Related information

For information about...	See...
Using the Plate Hotel or the Plate Hub Carousel in a protocol	*VWorks Automation Control User Guide*
Available devices	"BioCel System additional devices overview" on page 242

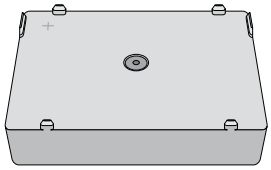
Platepad

About this topic

This topic describes the standard platepad, explains its use, and provides the configuration instructions.

Description

The standard platepad is a metal block on which a single microplate sits. Raised tabs on each side keeps the microplate in place.



Setup workflow

Step	Procedure	See...
1	Install the platepad.	Automation Solutions Technical Support
2	Add the platepad in the device file.	"Adding the platepad in the device file" on page 329
3	Set, edit, and verify the teachpoints for the platepad.	One of the following: • "Setting Direct Drive Robot teachpoints" on page 69 • "Setting 3-Axis Robot teachpoints" on page 117 • "Setting KiNEDx Robot teachpoints" on page 135

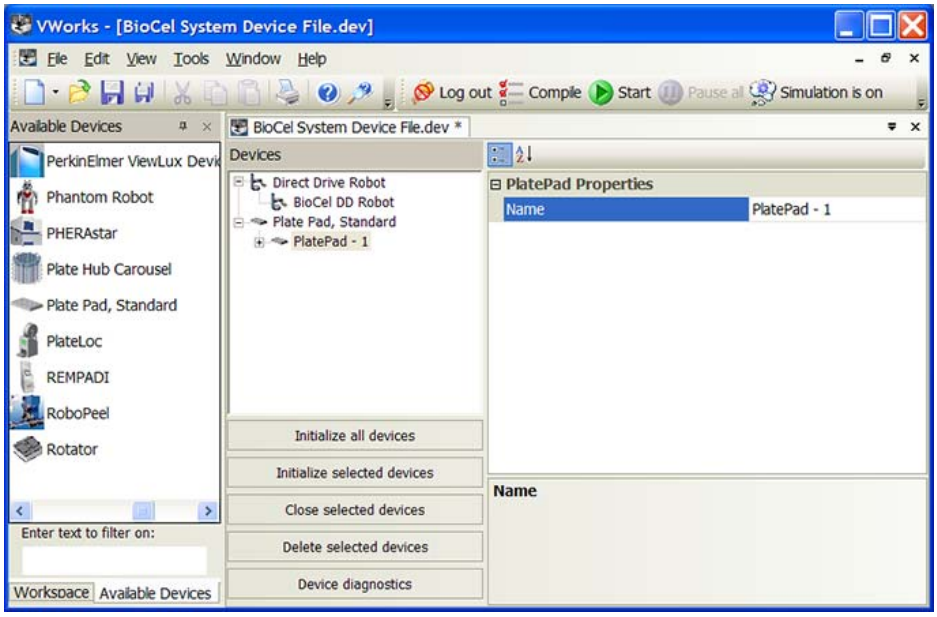
Adding the platepad in the device file

To place a microplate on or remove a microplate from a platepad, you must add the platepad device in the device file. The VWorks software is set up with the correct device configuration. You do not need to add a new platepad to the device file unless you want to use a different teachpoint file. For information about device files, see "Devices and device file defined" on page 39.

To add a platepad to the device file:

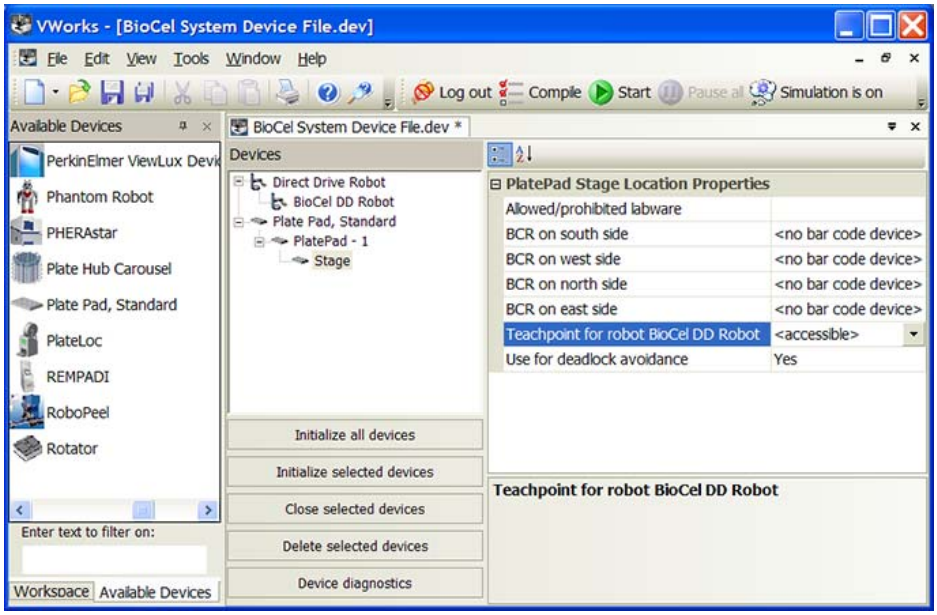
1 In the device file, add the Plate Pad. See "Adding and deleting devices in the software" on page 39 for instructions.

2 In the **PlatePad Properties** area, type the name of the platepad.



3 In the **Devices** area, expand the **Plate Pad**, and then select the **Stage** location.

4 In the **PlatePad Stage Location Properties** area, type or set the following:



Property	Description
Allowed/prohibited labware	Permitted labware class for the selected location. For example, you might specify that only tipboxes are allowed at a given location. For details on labware classes, see the *VWorks Automation Control Setup Guide*.

Property	Description
BCR on south/west/north/ east side	The location of the barcode reader and the desired barcode reader device. Use this field only if a barcode reader is installed on the device.
Teachpoint for robot <BioCel System Robot>	The name of the teachpoint to use for the stage location. This selection enables the robot to move correctly to and from the platepad or device during a protocol run. For example, if the robot teachpoint file contains a teachpoint for this platepad, you must select that teachpoint. *Note:* In simulation mode, select **<accessible>.**
Use for deadlock avoidance	Option to permit the location to be used for deadlock avoidance. Select **Yes** to permit labware to be moved to this location to avoid a deadlock in the system. Select **No** if you do not want to move random labware to this location to avoid deadlock.

5 Select **File > Save.**

Related information

For information about...	See...
Setting a platepad teachpoint	One of the following: • "Setting Direct Drive Robot teachpoints" on page 69 • "Setting 3-Axis Robot teachpoints" on page 117 • "Setting KiNEDx Robot teachpoints" on page 135
Available devices	"BioCel System additional devices overview" on page 242

Vacuum Delid Station

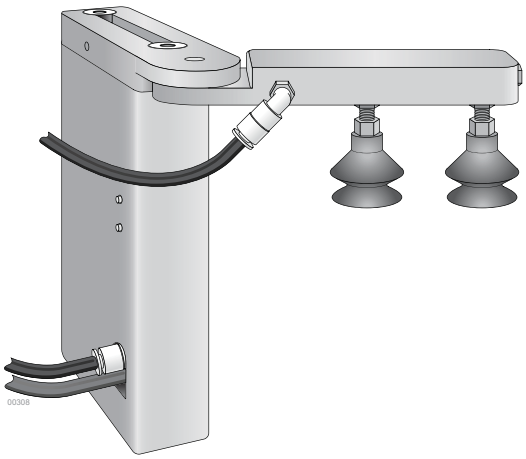
About this topic

This topic describes the Vacuum Delid Station, explains its use, and provides the configuration instructions.

Description

The Vacuum Delid Station is a static arm that sits over the waste-bin opening in the BioCel System table. Vacuum in the suction cups is used to remove labware lids that are dropped into the waste bin below the table.

Note: Vacuum is created using an air source.



Setup workflow

Step	Procedure	See...
1	Install the Vacuum Delid Station.	Automation Solutions Technical Support
2	Add the Vacuum Delid Station in the device file.	“Adding the Vacuum Delid Station in the device file” on page 333
3	Set, edit, and verify the teachpoint for the Vacuum Delid Station.	“Setting the teachpoint at the Vacuum Delid Station” on page 335

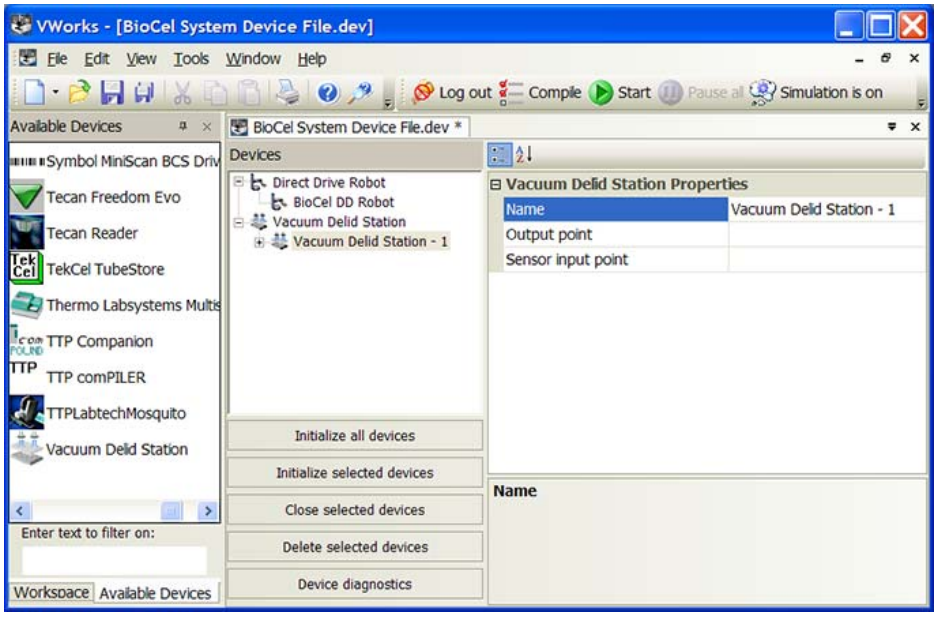
Adding the Vacuum Delid Station in the device file

The VWorks software is set up with the correct device configuration to communicate with the vacuum-based lid remover. You do not need to add a new vacuum-based lid remover to the device file unless you want to use a different teachpoint file. For information about device files, see "Devices and device file defined" on page 39.

To add the Vacuum Delid Station to the device file:

1 In the device file, add the Vacuum Delid Station device. See "Adding and deleting devices in the software" on page 39 for instructions.

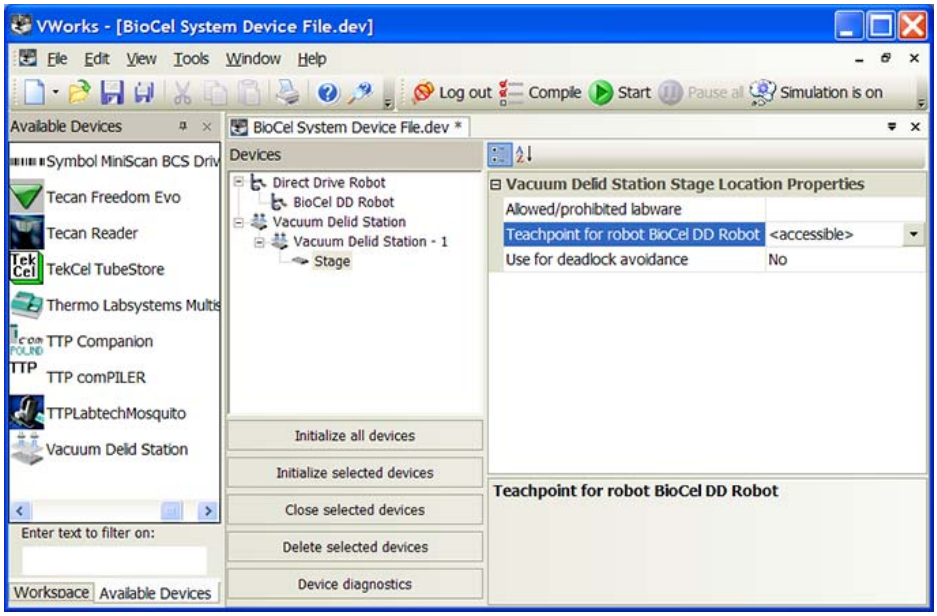
2 In the **Vacuum Delid Station Properties** area, type or select the following:



Property	Description
Name	The name of the Vacuum Delid Station device.
Output point	The BioCel I/O Interface port number that is used to turn on or turn off the vacuum.
Sensor input point	The BioCel I/O Interface port number that is used to detect whether the vacuum is turned on or turned off.

3 In the **Devices** area, expand the Vacuum Delid Station, and then select the **Stage** location.

4 In the **Vacuum Delid Station Location Properties** area, type or set the following:



Property	Description
Allowed/prohibited labware	Permitted labware class for the selected location. For example, you might specify that only tipboxes are allowed at a given location. For details on labware classes, see the *VWorks Automation Control Setup Guide*.
Teachpoint for robot <BioCel System Robot>	The name of the teachpoint for the stage location. This selection enables the robot to move correctly to and from the Vacuum Delid Station during a protocol run. For example, if the robot teachpoint file contains a teachpoint for this Vacuum Delid Station, you must select that teachpoint. *Note:* In simulation mode, select **<accessible>.**
Use for deadlock avoidance	Option to permit the location to be used for deadlock avoidance. Select **Yes** to permit labware to be moved to this location to avoid a deadlock in the system. Select **No** if you do not want to move random labware to this location to avoid deadlock.

5 Select **File > Save.**

Setting the teachpoint at the Vacuum Delid Station

To set the teachpoint at the Vacuum Delid Station, see one of the following:

- "Setting Direct Drive Robot teachpoints" on page 69
- "Setting 3-Axis Robot teachpoints" on page 117
- "Setting KiNEDx Robot teachpoints" on page 135

Direct Drive Robot procedure

When you set the Vacuum Delid Station teachpoint:

1. Install the provided teaching jig in the robot grippers.
2. Position the robot such that it is centered over the waste bin, and the bottom of the teaching jig is touching the top of the metal bar of the Vacuum Delid Station.
3. Set the teachpoint. Make sure you:
   - Set **Approach Ht (with labware)** and **Approach Ht (no labware)** at 0.
   - For **Place Custom Action,** select **Vacuum delid.**
4. Save the teachpoint.

3-Axis Robot and KiNEDx Robot procedure

When you set the Vacuum Delid Station teachpoint:

1. Open **Labware Editor** and:
   a. Make sure the labware definition for the lidded labware is correct. You will use the lidded labware for the teaching procedure.
   b. Record the **Lidded Thickness** and **Robot Gripper Offset** values on a piece of paper. You will use these values when you set the teachpoint at the Vacuum Delid Station.
2. Place the lidded labware at Plate Pad 1 (or at an existing teachpoint that the robot can access).
3. In robot diagnostics, use the correct commands to pick up the labware from Plate Pad 1 and move it to Nowhere. The robot should still be holding the labware at Nowhere.
4. Turn off the robot horizontal-axes motors.
5. Manually move the robot until the labware is centered over the waste bin and the top of the lidded labware should just touch the Vacuum Delid Station suction cups. You might have to jog the robot along the *z*-axis to correctly position the labware.

   Note: If possible, center the labware under the suction cups.
6. From this location, jog the robot up by 5 mm.
7. Turn on the robot horizontal-axes motors.
8. Open the robot grippers and remove the labware.
9. Jog the robot up by the Lidded Thickness value you recorded in step 1.
10. Jog the robot down by the Robot Gripper Offset value you recorded in step 1.
11. Set the teachpoint.
12. Save the teachpoint.

Related information

For information about...	See...
Setting up the BioCel I/O Interface	"BioCel I/O Interface" on page 251
Using the Vacuum Delid Station in a protocol	*VWorks Automation Control User Guide*
Lid Hotel Station	"Lid Hotel Station" on page 266
Available devices	"BioCel System additional devices overview" on page 242

Waste bin

About this topic

This topic describes the waste bin, explains its use, and provides the configuration instructions.

Description

Waste bin is a container that receives waste in the BioCel System. The software views the waste bin as a location (teachpoint) where the robot releases the labware that it has in its grippers. A receptacle for trash is typically positioned under this teachpoint.

Because it is a teachpoint and can be accessed by the robot, the waste bin is treated as a device in the software.

Setup workflow

Step	Procedure	See...
1	Install the waste bin.	Automation Solutions Technical Support
2	Add the waste bin in the device file.	"Adding the waste bin in the device file" on page 337
3	Set, edit, and verify the teachpoints for the waste bin.	One of the following: • "Setting Direct Drive Robot teachpoints" on page 69 • "Setting 3-Axis Robot teachpoints" on page 117 • "Setting KiNEDx Robot teachpoints" on page 135

Adding the waste bin in the device file

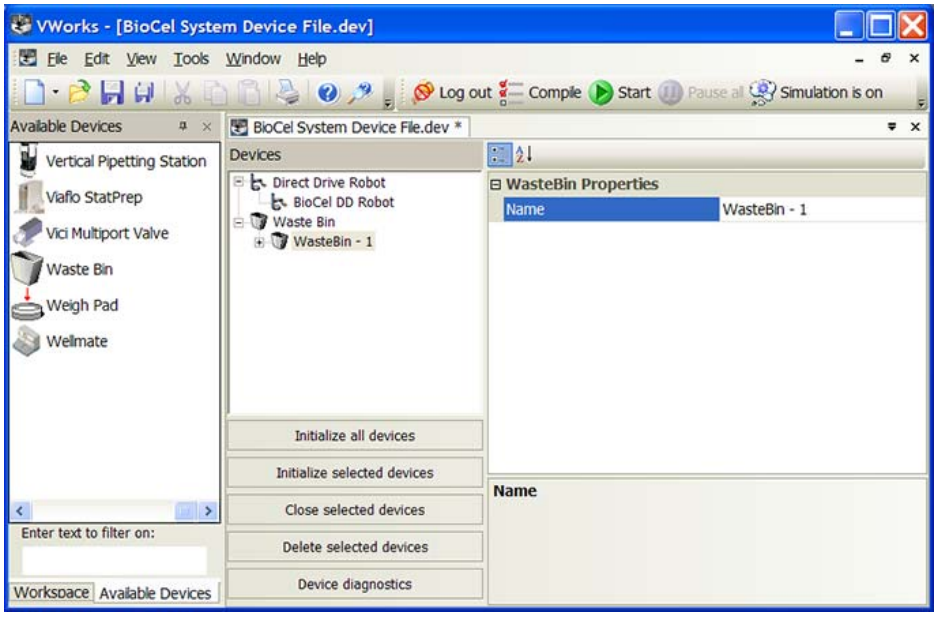
The VWorks software is set up with the correct device configuration. You do not need to add a new waste bin to the device file unless you want to use a different teachpoint file. For information about device files, see "Devices and device file defined" on page 39.

If the BioCel System is designed with an environmental chamber and an automated door separates the waste bin from the system, make sure you also add the door to the device file.

To add a waste bin to the device file:

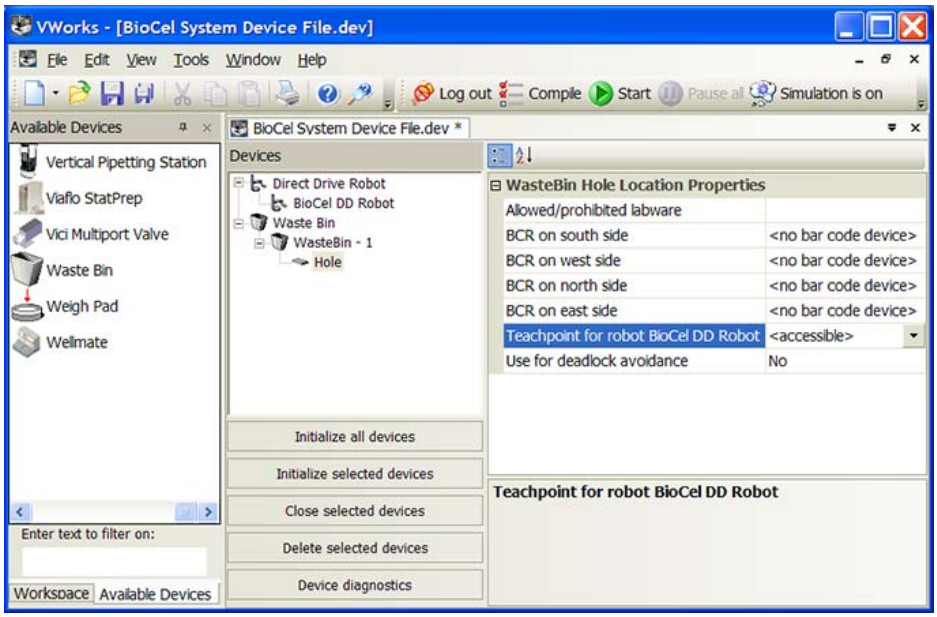
1 In the VWorks software, open the device file and add the Waste Bin device. See "Adding and deleting devices in the software" on page 39 for instructions.

2 In the **Waste Bin Properties** area, type a name for the Waste Bin.



3 In the **Devices** area, expand Waste Bin - 1, and then select **Hole,** the location where the robot will drop waste.

4 In the **Waste Bin Hole Location Properties** area, type or set the following:



Property	Description
Allowed/prohibited labware	Permitted labware class for the selected location. For example, you might specify that only tipboxes are allowed at a given location. For details on labware classes, see the *VWorks Automation Control Setup Guide*.

Property	Description
BCR on south/west/north/ east side	The location of the barcode reader and the desired barcode reader device. Use this field only if a barcode reader is installed on the device.
Teachpoint for robot <BioCel System Robot>	The name of the teachpoint to use for the Hole location. This selection enables the robot to move correctly to and from the Waste Bin during a protocol run. For example, if the robot teachpoint file contains a teachpoint for this Waste Bin, you must select that teachpoint. *Note:* In simulation mode, select **<accessible>.**
Use for deadlock avoidance	Option to permit the location to be used for deadlock avoidance. Select **Yes** to permit labware to be moved to this location to avoid a deadlock in the system. Select **No** if you do not want to move random labware to this location to avoid deadlock.

5 Select **File > Save.**

To add a waste-bin door to the device file:

1 In the VWorks software, add the waste bin Door device. See "Adding and deleting devices in the software" on page 39 for instructions.

2 When setting up the waste bin door, be sure to specify the BioCel I/O Interface input and output signals to be used. For detailed instructions, contact Automation Solutions Technical Support.

3 Select **File > Save.**

Related information

For information about...	See...
Setting a waste teachpoint	One of the following: • "Setting Direct Drive Robot teachpoints" on page 69 • "Setting 3-Axis Robot teachpoints" on page 117 • "Setting KiNEDx Robot teachpoints" on page 135
Setting up the BioCel I/O Interface	"BioCel I/O Interface" on page 251
Available devices	"BioCel System additional devices overview" on page 242

Weigh Pad

About this topic

This topic describes the Weigh Pad, explains its use, and provides the configuration instructions.

Description

A Weigh Pad is an electronic monitor that checks the percentage of liquid in the bottle resting on the Weigh Pad. By monitoring the weight of the bottle, the Weigh Pad controls when the Pump Module is activated. The Weigh Pad works with the Pump Module to maintain an optimum level of liquid and ensures the bottle is not overfilled. If no Pump Module is used, an alarm can be set up to sound when the liquid level is too low or too high.

Multiple Weigh Pads are connected to the Weigh Pad hub. The hub enables communication between the Weigh Pads and the controlling computer. For a detailed description and location of the Weigh Pad hub, see "Weigh Pad hub (optional)" on page 20.

Two sizes of Weigh Pads are available: Large and small. The Weigh Pad size should accommodate the bottle size.

Setup workflow

Step	Procedure	See...
1	Install the Weigh Pad.	Automation Solutions Technical Support
2	Add the Weigh Pad in the device file.	"Adding the Weigh Pad in the device file" on page 341
3	Create a profile for the Weigh Pad.	"Creating a profile for the Weigh Pad" on page 341
4	Set up the bottle library.	"Setting up the bottle library" on page 343
5	Calibrate the Weigh Pads.	"Calibrating the Weigh Pads" on page 344
6	View the bottle status.	"Viewing the bottle status" on page 345

Note: Weigh Pads are typically installed under the system table and do not interact with the robot. Therefore, you do not need to set teachpoints for Weigh Pads.

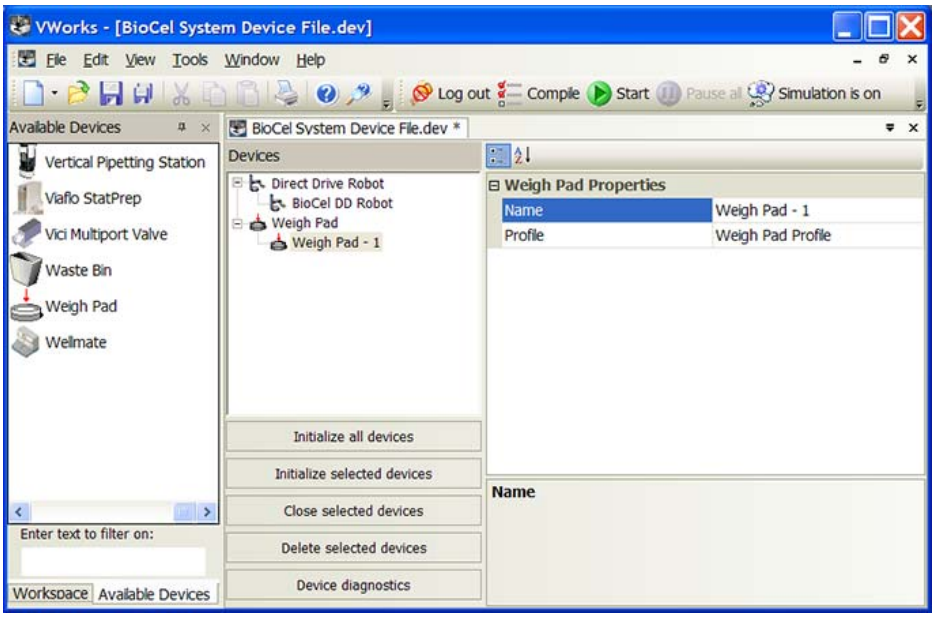
Adding the Weigh Pad in the device file

The VWorks software is set up with the correct device configuration for the Weigh Pad. You do not need to add a new Weigh Pad to the device file unless you want to add more Weigh Pads to the system. For information about device files, see "Devices and device file defined" on page 39.

To add the Weigh Pad to the device file:

1 In the VWorks software, open the device file and add the Weigh Pad. See "Adding and deleting devices in the software" on page 39 for instructions.

2 In the **Weigh Pad Properties** area, type or select the following:



Property	Description
Name	The name of the Weigh Pad device.
Profile	The profile associated with the device. Select the desired profile from the list. If you have not created a profile, see "Creating a profile for the Weigh Pad" on page 341, and then return to this step to select the profile.

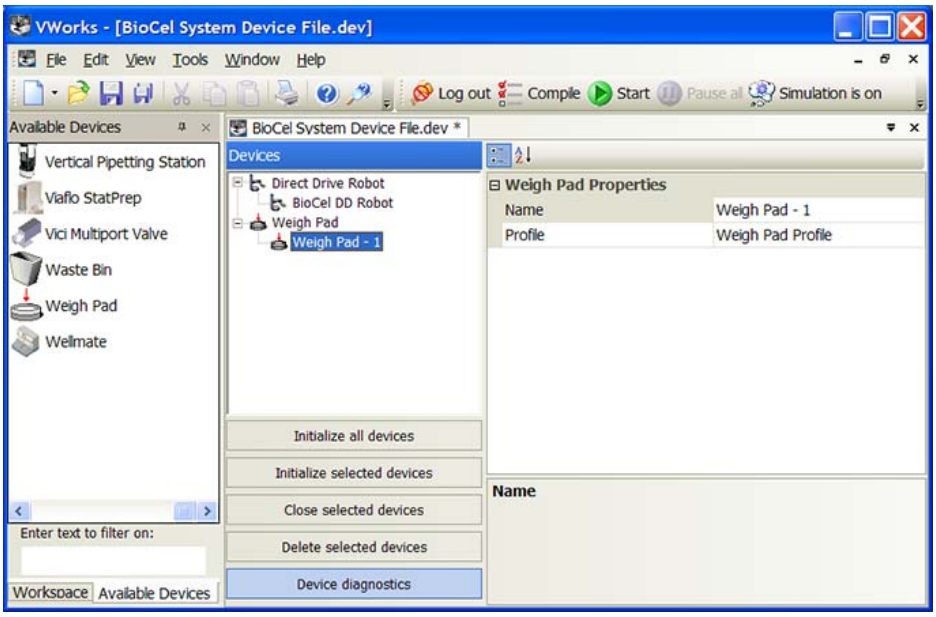
3 Select **File > Device File > Save.**

Creating a profile for the Weigh Pad

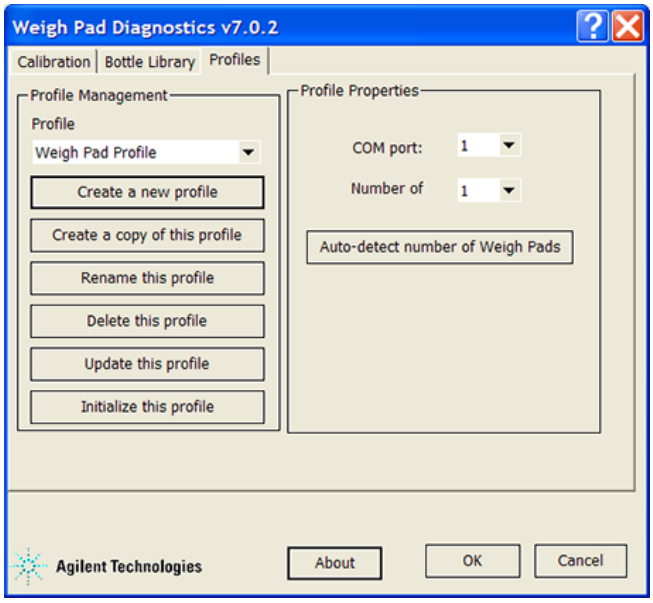
The Weigh Pad profile allows you to set up communication between the Weigh Pad and the controlling computer.

To create a profile:

1 In the VWorks software, open **Weigh Pad Diagnostics.**



The Weigh Pad Diagnostics dialog box opens.



2 Click the **Profiles** tab.

3 Click **Create a new profile.** The Create Profile dialog box opens.

4 Type a name for the new profile, and then click **OK.** The new profile name appears in the Profile area.

5 In the **Profile Properties** area:

- **a** In the **COM port** list, select the serial port that connects the Weigh Pad to the controlling computer.
- **b** In the **Number of** list, select the number of Weigh Pads that are installed.
- **c** If you are not sure how many Weigh Pads are connected to the system, click **Auto-detect modules.** The Number of Weigh Pads updates.

6 Click **Update this profile** to save the changes.

7 Click **Initialize this profile** to establish communication with the Weigh Pad.

8 Return to the device file and select the profile for the Weigh Pad device.

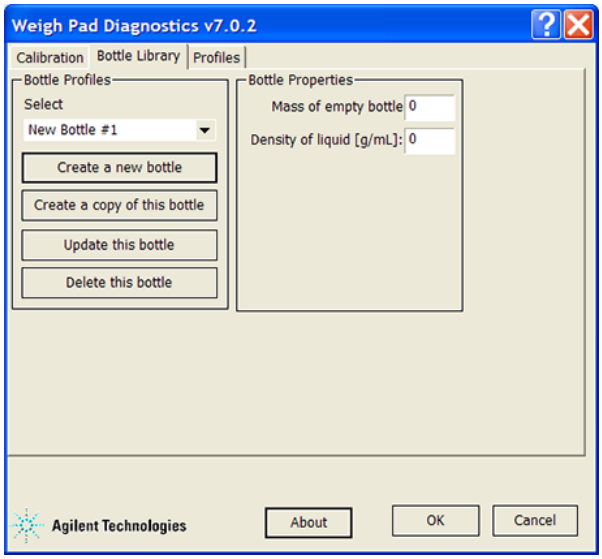
Setting up the bottle library

For each bottle you want the system to monitor, you must specify the weight of the bottle and the density of its contents. The software will use the information to maintain optimum liquid level and prevent overfilling.

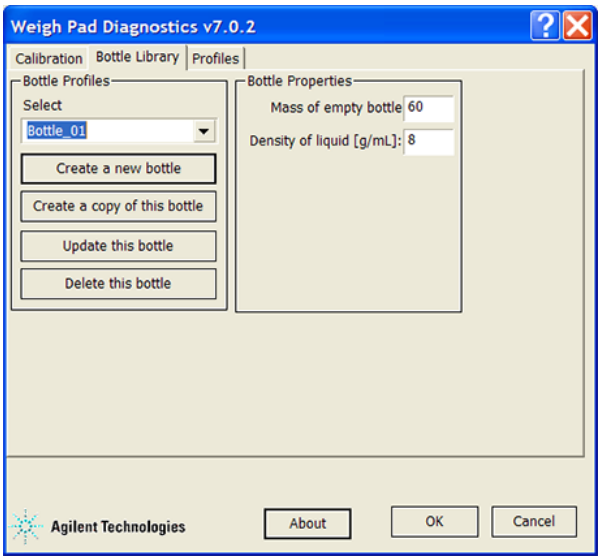
To set up the bottle library:

1 In **Weigh Pad Diagnostics,** click the **Bottle Library** tab.

2 In the **Bottle Profiles** area, click **Create a new bottle.** A new default bottle name appears in the Select list.



3 To change the bottle name, double-click the default bottle name, type a new name, and then click **Rename this bottle.** The new name appears in the Select list.



4 In the **Bottle Properties** area:

   a In the **Mass of empty bottle** box, type the mass (weight) of the empty bottle in grams.

   b In the **Density of liquid** box, type the density of the liquid in grams per liter.

5 Click **Update this bottle.**

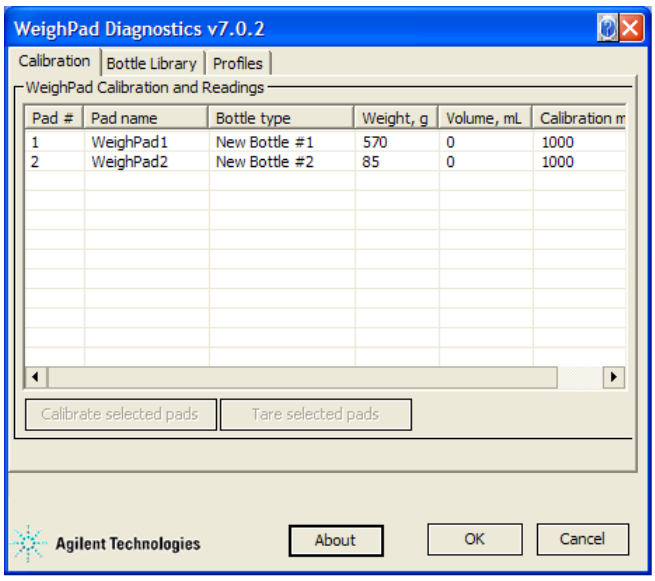
6 Repeat steps 2 through 5 for the remaining bottles.

Calibrating the Weigh Pads

To ensure the system accurately monitors the bottles and their contents, you must calibrate the Weigh Pads.

To calibrate the Weigh Pads:

1 In **Weigh Pad Diagnostics,** click the **Calibration** tab.



2 In the **Weigh Pad Calibration and Readings** table, select the Weigh Pad you want to calibrate.

3 Click **Calibrate selected pads.** A dialog box opens. Follow the instructions in the dialog box to add or remove the liquid you want to use for the calibration process. If the calibration is correct for the density of the liquid, the dialog box displays a volume, in milliliters.

4 Place the empty bottle on the Weigh Pad.

5 Click **Tare selected pads** to set the Weight and Volume reading at 0.

6 When you are finished calibrating and taring the Weigh Pad, click **OK** to save the changes.

Viewing the bottle status

To view the bottle status:

1 In **Weigh Pad Diagnostics,** click the **Calibration** tab.

2 In the **Weigh Pad Calibration and Readings** table, check the following:

Column	Description
Pad #	The numeric identifier that is assigned to a Weigh Pad as it is added in the software.
Pad name	The name associated with the Weigh Pad. You can provide a name for the Weigh Pad. To do this, double-click in the Pad name cell, and then type a name.
Bottle type	The bottle on the Weigh Pad. The bottle type information is obtained from the bottle profile.
Weight, g	The current weight of the bottle and its contents.
Volume, mL	The current volume of liquid in the bottle. The software calculates the volume from the bottle information (weight of empty bottle and liquid density).
Calibration mass, g	The weight used to calibrate the Weigh Pad.

Related information

For information about...	See...
Using the Weigh Pad in a protocol	*VWorks Automation Control User Guide*
Available devices	"BioCel System additional devices overview" on page 242

B
Block diagrams

This appendix provides block diagrams and descriptions of the following:

- "Power system" on page 348
- "Air system" on page 351
- "Vacuum system" on page 353

Power system

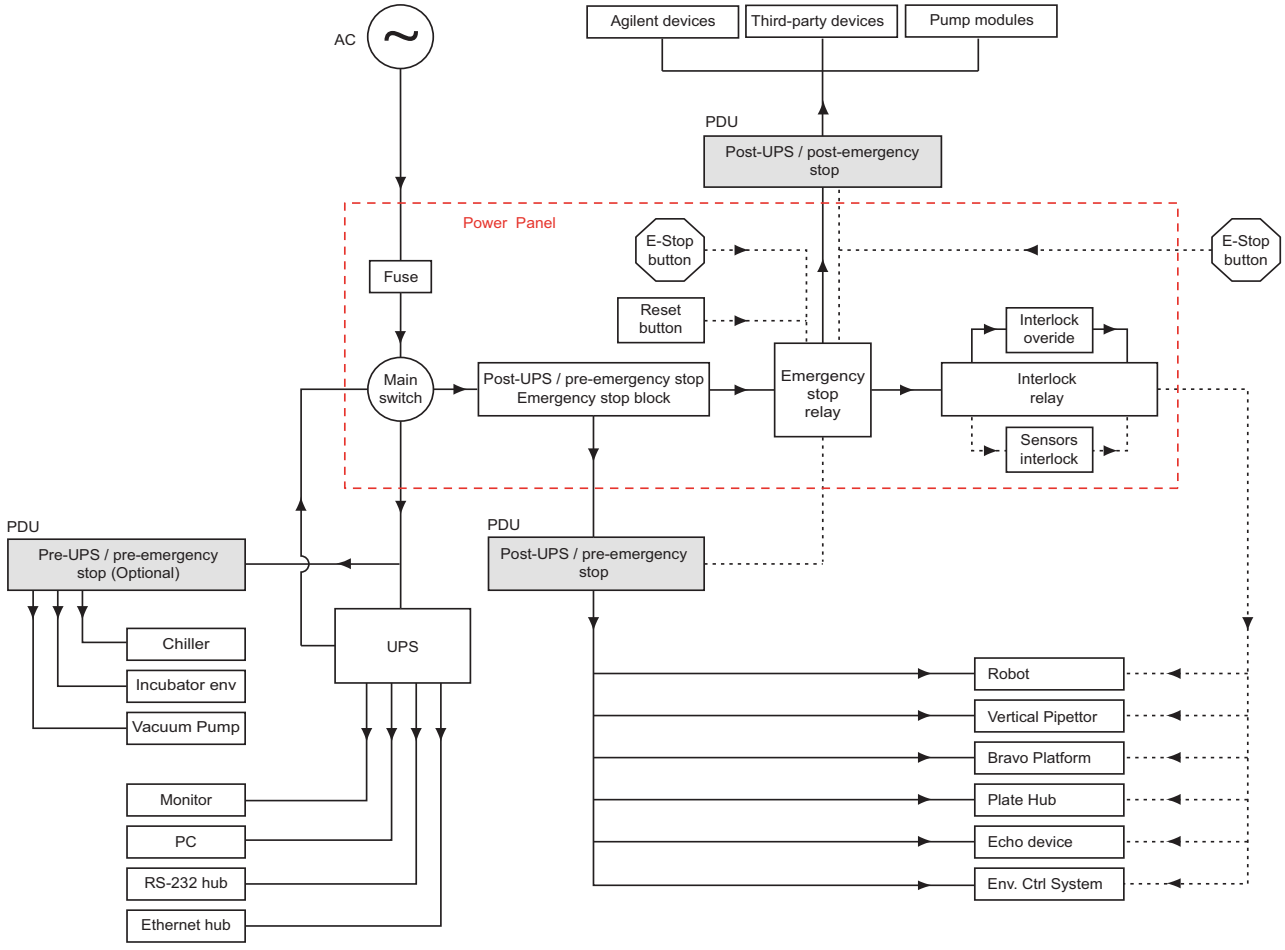
About this topic

This topic summarizes the power system of the BioCel System. Becoming familiar with how your BioCel System is wired will help you to understand the behavior of your BioCel System and solve problems.

Overview diagram

The power system is summarized in the following diagram. Dotted lines are signal circuits and solid lines are AC and DC power circuits. Those elements that lie inside the power panel are enclosed in red dotted lines.

Note: By default, the system contains the following power strip connections: two post-UPS/post-emergency stops, one post-UPS/pre-emergency stop, and one optional pre-UPS/pre-emergency stop.



Main power

The main AC power enters at the external connections and travels down inside the corner post to the power panel. It passes through a main fuse, through the main switch, and out of the power panel to the UPS.

Pre-UPS, pre-emergency stop current

One or more electrical lines branch off before the UPS to supply current to devices that do not require backup power supply. Some examples of these optional devices include:

- Cooling and heating water baths
- Environmental controller console that houses the controllers for the main BioCel (not for any separate environmental enclosures)
- Incubators (environmental control, not transfer mechanism)

Because these devices receive pre-UPS, pre-emergency stop current, they are not affected by emergency stops or interlocks. However, they are not buffered by the UPS from power outages.

UPS connections

From the UPS, current is passed back into the power panel and through the main switch to the rest of the BioCel System. This means that when you turn off the main switch, current is cut to the UPS, but it is also cut between the UPS and the main part of the BioCel System, preventing the BioCel System and its devices from draining the UPS. The UPS will continue to be drained by the computer, monitor, and communication hubs, which is why the shutdown procedure includes a step for turning off the UPS.

Pre-emergency stop

After the main switch, the electrical line enters a bank of connections in the power panel known as the pre-emergency stop block. A pre-emergency stop power strip is connected to this block. Devices wired from the pre-emergency stop power strip do not have their power cut when an emergency stop is activated. For example, the robot retains power after activation of an emergency stop because its DC power is supplied by the robot DC power supply fed from the pre-emergency stop block.

Emergency stop and interlocks

An electrical line from the pre-emergency stop block enters the emergency stop relay which controls the emergency stop circuit. One output from the emergency stop relay powers an interlock circuit switch. Another output supplies the BioCel System power strips from which most of the BioCel System devices and system components receive current. These devices and system components are all wired after the emergency stop and therefore receive no current when an emergency stop is activated. This includes the BioCel I/O Interface and cooling fans, which use DC electricity produced by the system DC power supply.

If an emergency stop is activated, the reset button must be pushed to reset the emergency stop relay to a position that allows current to flow.

The window interlock system creates a circuit with the emergency stop relay. If an interlock relay (window) is opened during a run, the circuit is disrupted, thus stopping the robot servos, the Vertical Pipetting Station motors, and the Bravo Platform motors, and turns on their respective z-axis brakes. The brakes make sure that the pipette head and robot do not drop, preventing damage and eliminating a crushing hazard.

The interlock system is bypassed when the interlock override switch is activated by turning a key on the power panel. This maintains current in the enable wires even when the interlock relays are open.

Related information

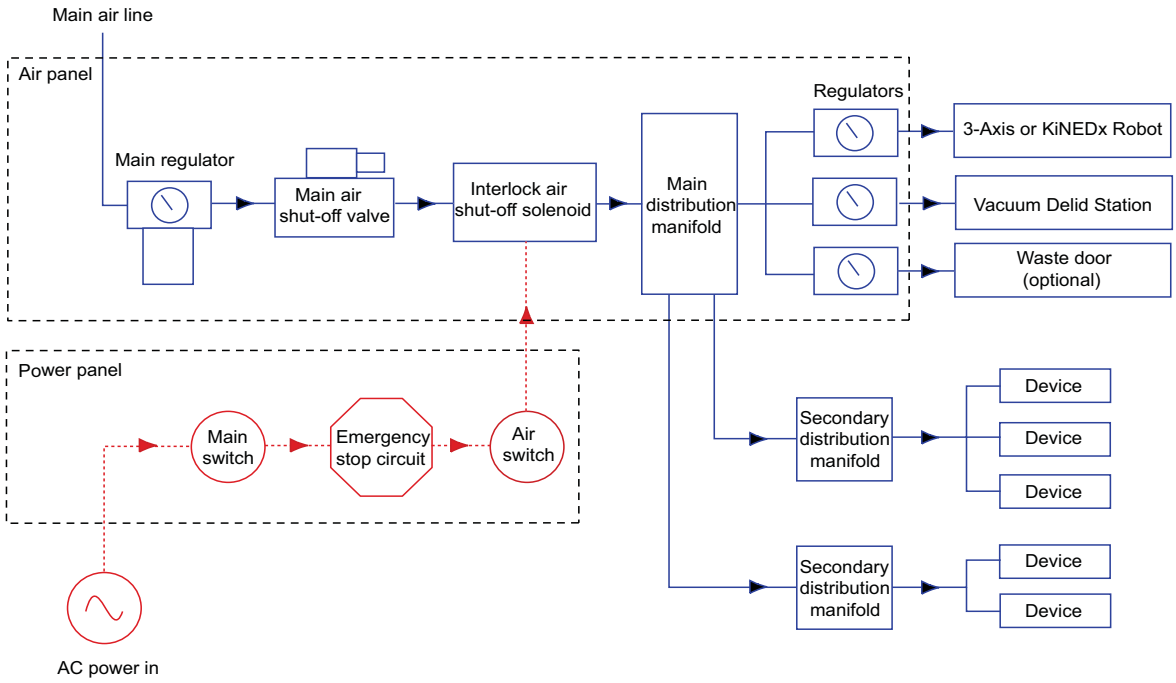
For information about...	See...
Systems affected by interlocks and emergency stops	"Power system" on page 348
Stopping a run in an emergency	*BioCel System Safety Guide*
Turning the BioCel System off	"Starting up and shutting down the BioCel System" on page 32

Air system

Air and power interaction

The following diagram shows how the air and power systems interact. Becoming familiar with these systems will help you to understand the behavior of your BioCel System and solve problems.

Note: The Direct Drive Robot does not require air supply to operate.



Air system description

Air is used on the BioCel System to:

- Move parts, such as the 3-Axis Robot or KiNEDx Robot grippers, Labware Stacker grippers, and Vertical Pipetting Station shelves
- Create a vacuum, such as for the Vacuum Delid Station

The flow of air through the system is controlled by air pressure regulators. Many devices have their own built-in regulators. Air pressure to other parts is controlled by regulators in the air panel of the BioCel System.

The diagram above shows how air to the BioCel System can be cut off:

- Turning off the AIR switch on the power panel
- Turning off the main air shutoff valve in the air panel
- Turning off the main power in the power panel
- Pressing an emergency stop button (for emergency stops only)

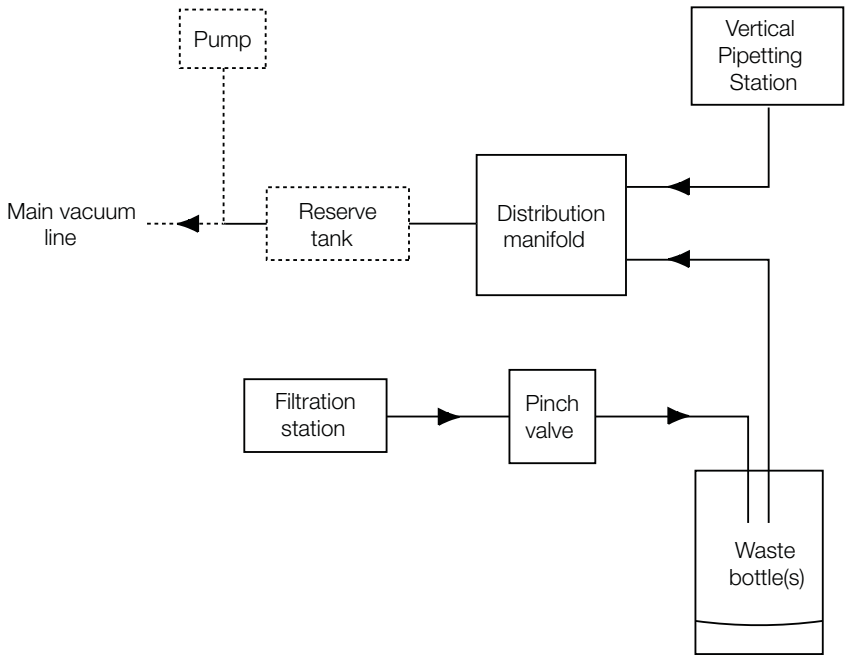
Related information

For information about...	See...
Power system	“Power system” on page 348
Vacuum system	“Vacuum system” on page 353
Emergency stop	*BioCel System Safety Guide*

Vacuum system

Vacuum flow diagram

The following diagram shows the vacuum flow in the optional vacuum system.



Vacuum system description

A vacuum may be used on the BioCel System for:

- Filtration stations
- Suction to hold plates flat on a Vertical Pipetting Station shelf
- Third-party devices

The vacuum can be supplied by a pump or house vacuum system. If a house vacuum system is used, the main vacuum line enters the BioCel System with the other external connections. If a pump is used, it will be located on the floor of the BioCel System.

A reserve vacuum tank may be used to ensure an instantaneous vacuum supply.

Waste liquid produced by filtration stations is collected in one or more waste containers.

Vacuums are also created in devices using vacuum ejectors that create the vacuum at the site where it is required, such as at the Vacuum Delid Station.

Related information

For information about...	See...
Power system	“Power system” on page 348
Air system	“Air system” on page 351
Emergency stop	*BioCel System Safety Guide*

C
Quick reference

This appendix provides a quick reference of the following:

- “DDR Diagnostics” on page 356
- “3-Axis Robot Diagnostics” on page 375
- “KiNEDx Robot Driver Diagnostics” on page 381

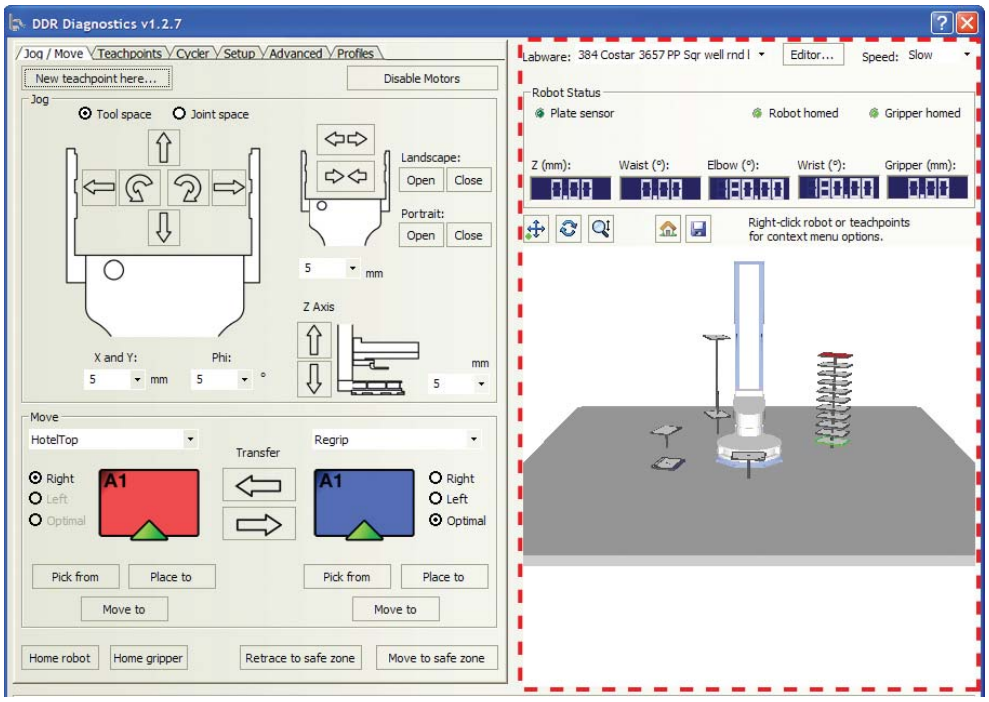
For information about the Staubli robot, see the *Staubli TX60 Device Driver User Guide*.

DDR Diagnostics

This topic explains the menu commands, selections, options, and status information in the DDR Diagnostics dialog box. The topics are:

- "Robot status area" on page 356
- "Log area" on page 358
- "Jog/Move tab" on page 359
- "Teachpoints tab" on page 365
- "Cycler tab" on page 368
- "Setup tab" on page 369
- "Advanced tab" on page 371
- "Profiles tab" on page 373

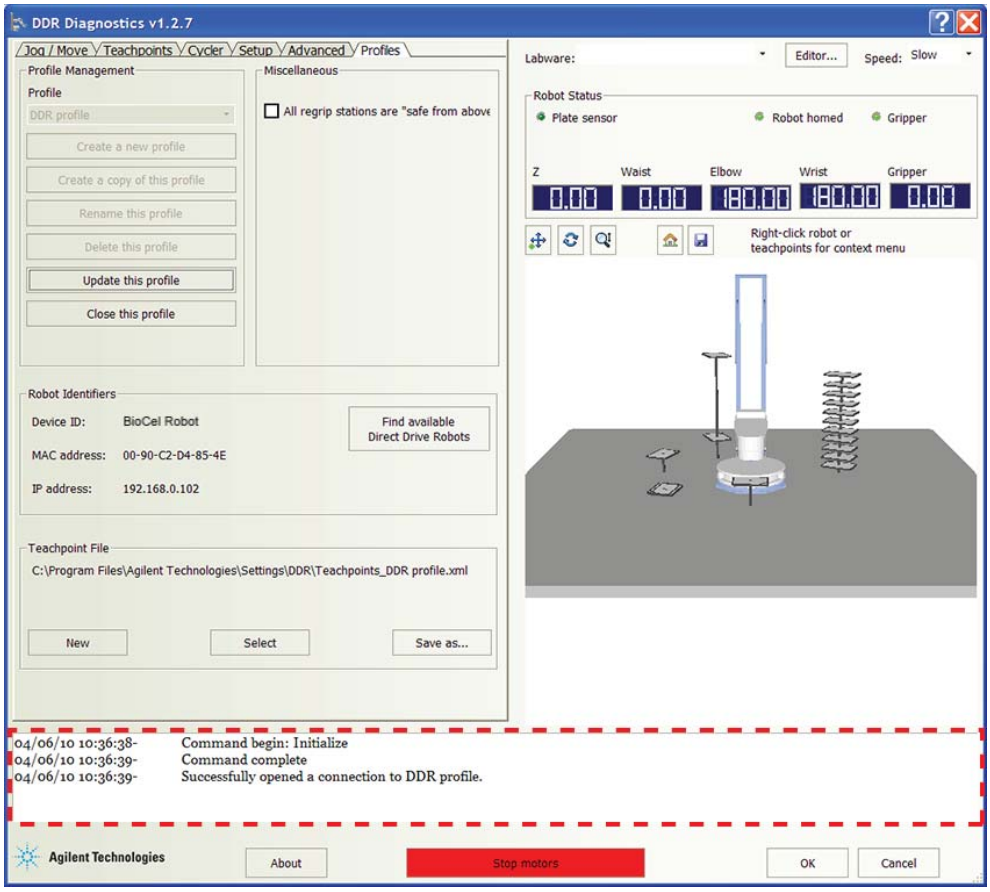
Robot status area



Selection or command	Description
Labware	Allows you to select a labware.
Editor	Opens the Labware Editor.
Speed	Sets the robot speed: Slow, Medium, or Fast.

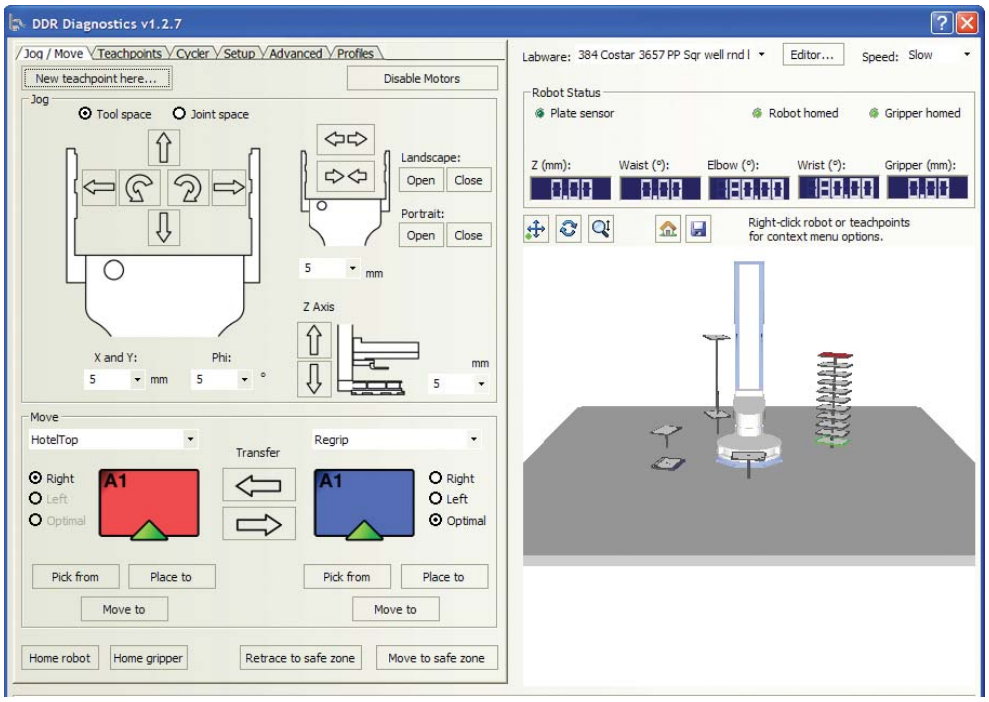
Selection or command	Description
Plate sensor	Indicates the presence of labware in the robot grippers. If the indicator light is on, a labware is in the robot grippers. If the indicator light is off, the sensor does not detect a labware in the robot grippers.
Robot homed	Indicates that the robot is in the factory-defined home position.
Gripper homed	Indicates that the robot grippers are in the factory-defined home position.
Z (mm)	Displays the current *z*-axis coordinate relative to the home position.
Waist (°)	Displays the current waist coordinate relative to the home position.
Elbow (°)	Displays the current elbow coordinate relative to the home position.
Wrist (°)	Displays the current wrist coordinate relative to the home position.
Gripper (mm)	Displays the current distance between the two grippers.
	Pans, or moves the image. Click the button, and then drag the image in the desired direction.
	Rotates the image. Click the button, and then drag the image to rotate it in the desired direction. Alternatively, click the middle mouse button or wheel, and then drag the image to rotate it.
	Increases or reduces the image magnification. Click the button, and then drag the image upward or downward to increase or decrease the magnification respectively. Alternatively, scroll the mouse wheel to change the magnification.
	Resets the image to the default view.
	Saves the current view as the default view.

Log area



Shows the status of the commands, actions, and progress as you work in the dialog box.

Jog/Move tab

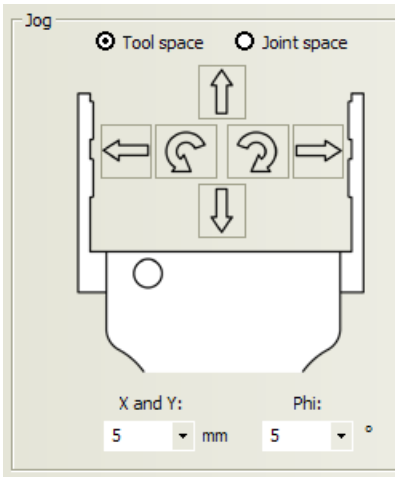


General commands

Command	Description
New teachpoint here	Creates a new teachpoint at the current coordinates.
Disable Motors/Enable Motors	Disables or enables the robot joint motors. When disabling the motors, the robot will first finish the current command before stopping. For safety reasons, disabling the motors disables the joint motors only. You cannot disable the *z*-axis motor.
Home robot	Sends the robot to the factory-defined home position for each of the axes of motion.
Home gripper	Sends the grippers to the factory-defined home position. *Note:* Homing the grippers does not home the rest of the robot.

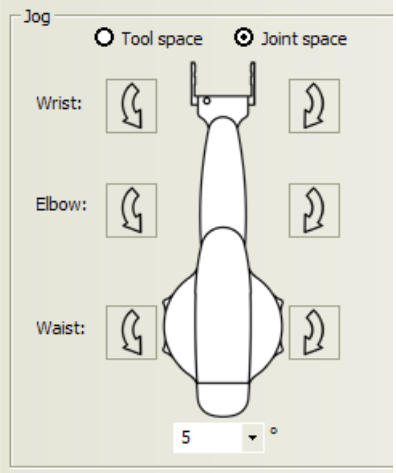
Command	Description
Retrace to safe zone	Enables the robot to search for the closest teachpoint, and then use the path from that teachpoint to return to the safe zone. If the robot is unable to find a teachpoint nearby, it will retreat into the safe zone by retracing the path it took to reach the current location. Use the Retrace to safe zone command when, for example, the robot grippers are within a device, and using the Move to safe zone command might cause the robot to run into the sides of the device or other obstacles.
Move to safe zone	Enables the robot to search for the closest teachpoint, and then use the path from that teachpoint to return to the safe zone. If the robot is unable to find a teachpoint nearby, it retracts radially into the safe zone. Use the Move to safe zone command if it is close to a teachpoint and the path from that teachpoint to the safe zone is clear or obstacles.
Stop Motors	Immediately cuts power to the robot motors, thus stopping the robot.
About	Displays the DDR Diagnostics version number and copyright information.

Jog area: Tool space commands



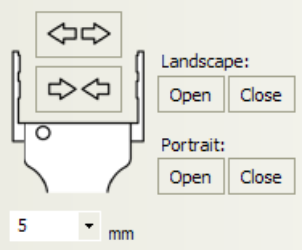
Command or parameter	Description
Tool space	Displays the jog buttons to move the robot waist, elbow, wrist, and arm so that the labware moves to its target location along the *x*- or *y*-axis. In addition, you can rotate the labware (*Phi* angle) and move the robot arm up and down along the mast or *z*-axis. In tool space, all movements are measured with respect to the center of the labware.
Tool space jog buttons: X: Y: Phi:	Jogs the robot in the specified direction by the specified distance in millimeters or by the specified angle.
X and Y jog increment	Specifies the distance, in millimeters, the robot moves when you click an *x*- or *y*-axis jog button.
Phi jog increment	Specifies the distance, in degrees, the labware rotates when you click a rotating jog button.

Jog area: Joint space commands



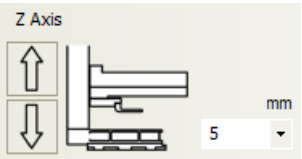
Command or parameter	Description
Joint space	Displays the jog buttons to rotate the robot's entire body about its waist joint, rotate its forearm about its elbow joint, and rotate its hand about the wrist joint. In addition, you can move the robot arm up and down along the mast or *z*-axis.
Wrist/Elbow/Waist jog buttons:	Jogs the robot in the specified direction by the specified degrees.
Joint jog increment	Specifies the angle, in degrees, the robot rotates when you click a rotating jog button.

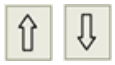
Jog area: Gripper commands



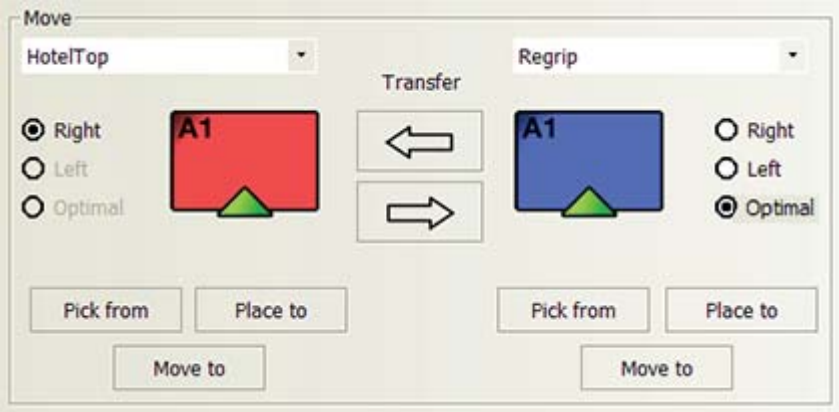
Command or parameter	Description
Landscape: Open/Close	Opens or closes the robot grippers to accommodate the landscape labware orientation.
Portrait: Open/Close	Opens or closes the robot grippers to accommodate the portrait labware orientation.
Gripper jog buttons:	Opens or closes the robot grippers by the specified distance.
Gripper jog increment	Specifies the distance, in millimeters, the robot grippers move when you click an open or close gripper jog button.

Jog area: Z-axis commands



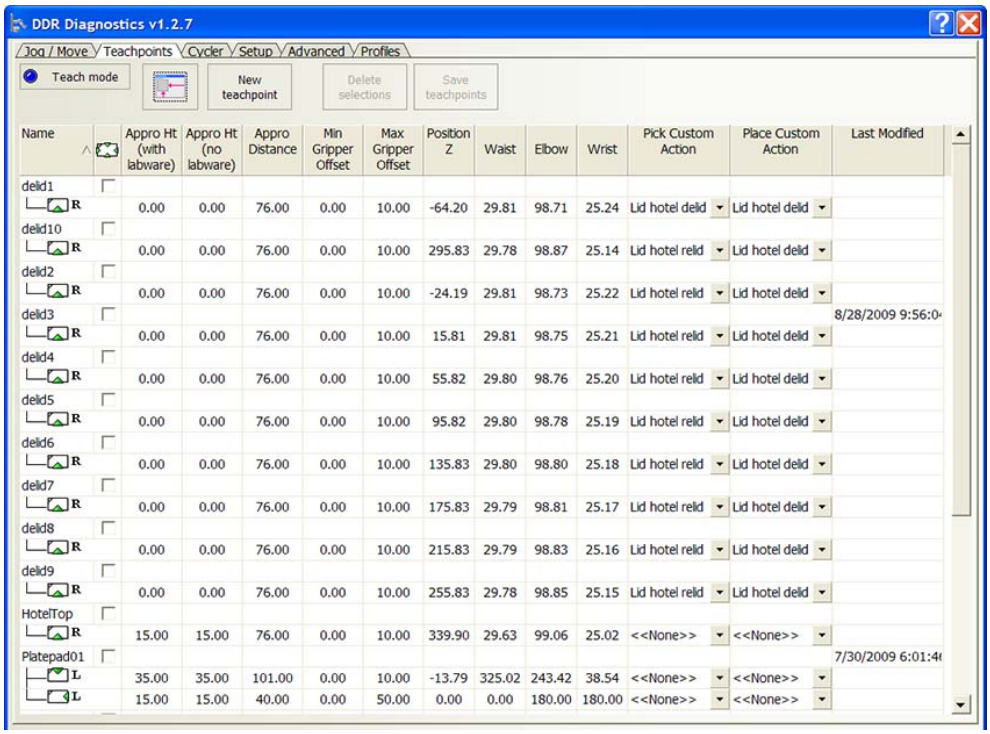
Command or parameter	Description
Z Axis jog buttons: 	Jogs the robot along the *z*-axis in the specified direction by the specified distance.
Z Axis jog increment	Specifies the distance, in millimeters, the robot moves when you click one of the Z Axis jog buttons.

Move area



Selection or command	Description
Teachpoint selection	Allows you to select from the list of available teachpoints.
Right/Left/Optimal	Specifies the robot-arm orientation at the selected teachpoint.
Transfer buttons:	Picks up labware from a selected teachpoint and places the labware at the other selected teachpoint.
Pick from	Picks up labware from the selected teachpoint.
Place to	Places labware at the selected teachpoint.
Move to	Moves the robot grippers to the selected teachpoint.

Teachpoints tab



Commands

Command	Description
Teach mode	Enables you to move the robot arm and hand freely without resistance.
(Maximize/Minimize)	Displays all of the columns or displays the first few columns in the teachpoints table.
New teachpoint	Adds a new teachpoint in the table.
Delete selections	Deletes the selected teachpoints.
Save teachpoints	Saves the changes made to the teachpoints.

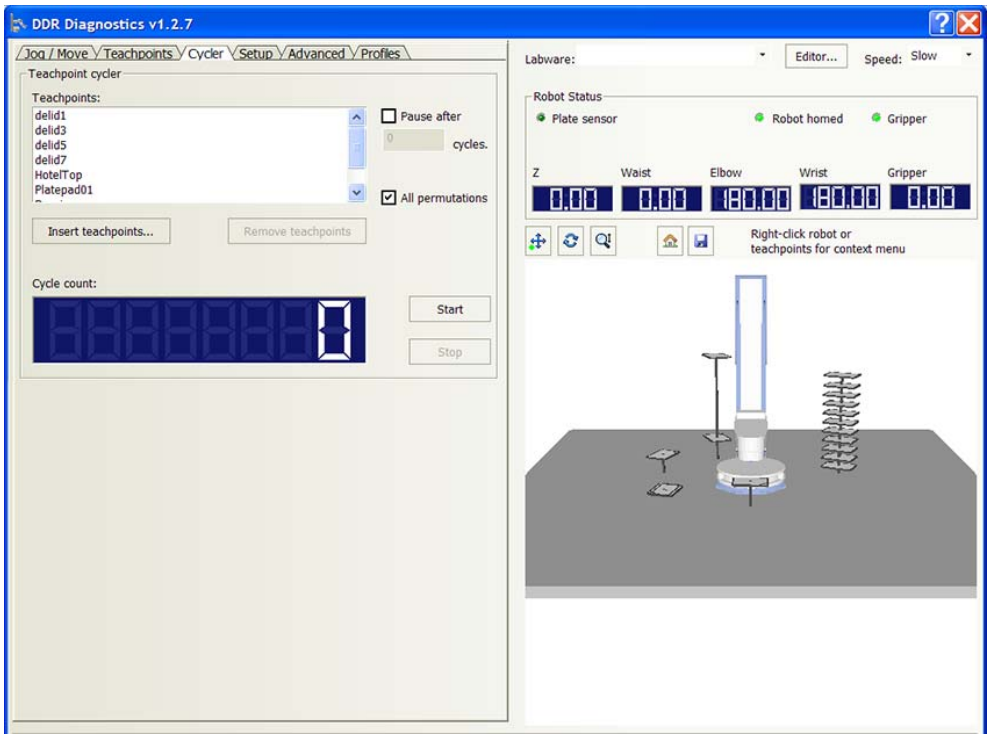
Teachpoints table

Column name	Description
Name	The name of the teachpoint. To change the name, double-click the box and type the new name.

Column name	Description
Orientation	The orientation of the labware from the robot's perspective. Double-click to change the A1 well orientation. *Note:* You cannot change the robot-arm orientation (R or L) or the labware orientation (portrait or landscape). The software automatically sets these orientations when you set the teachpoint.
Regrip Station	The regrip station designation. Select the check box to designate the teachpoint as a regrip station. *Note:* Regrip stations cannot be used for other purposes such as deadlock avoidance.
Approach Ht (with labware)	The height clearance, in millimeters, the robot must maintain above the teachpoint as it moves towards or away from the teachpoint with labware in its grippers.
Approach Ht (no labware)	The height clearance, in millimeters, the robot must maintain above the teachpoint as it moves towards or away from the teachpoint with no labware in its grippers.
Approach Distance	The distance, in millimeters, from the teachpoint within which the robot must: • Maintain the specified approach height. • Move in a straight line toward or away from the teachpoint.
Minimum Gripper Offset	The vertical distance, in millimeters, from the teachpoint to the lowest point where the grippers will hold the labware at the teachpoint. The default value is 0 mm. This value is used with the Maximum gripper offset value to define a range within which the grippers can hold the labware at the teachpoint location. **IMPORTANT** During the run, the VWorks software checks the gripper offset range defined in this tab and the range in the labware's definition. **IMPORTANT** For regrip stations, make sure the range can accommodate all labware.

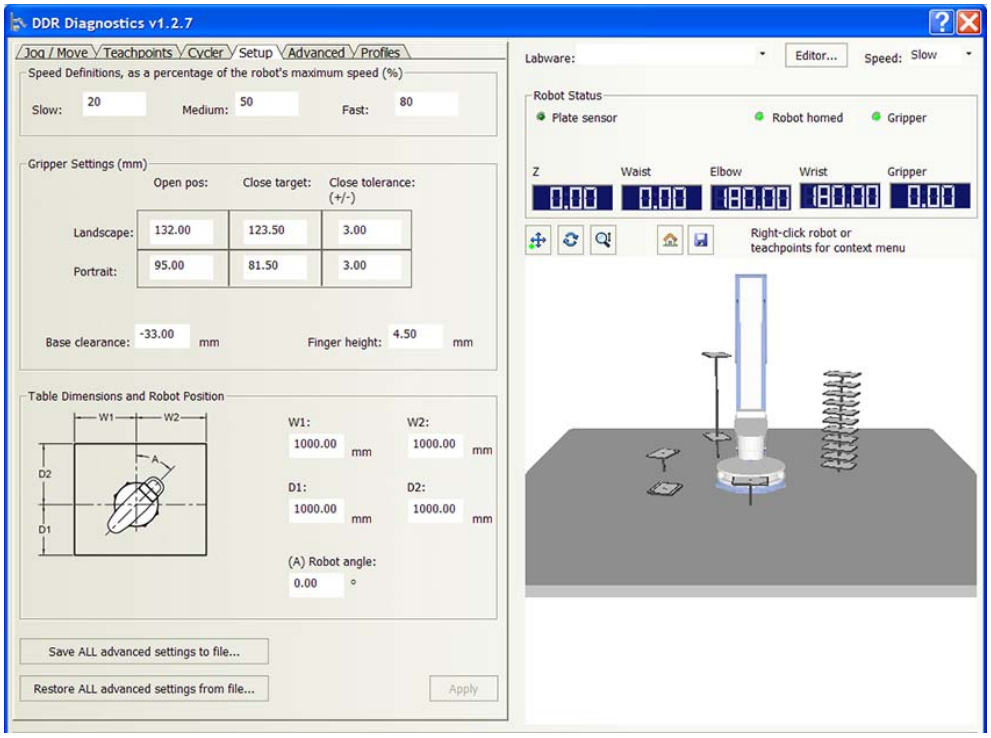
Column name	Description
Maximum Gripper Offset	The vertical distance, in millimeters, from the teachpoint to the highest point where the grippers will hold the labware at the teachpoint. The default value is 10 mm. This value is used with the Minimum gripper offset value to define a range within which the grippers can hold the labware at the teachpoint location.
Position Z	The *z*-axis coordinate of the robot measured in millimeters.
Waist	The waist joint coordinate.
Elbow	The elbow joint coordinate.
Wrist	The wrist joint coordinate.
Pick Custom Action	The actions that the robot will perform at the teachpoint. Use the Pick Custom Action to: • Relid labware at a Lid Hotel Station. • Stir the labware at the teachpoint.
Place Custom Action	The actions that the robot will perform at the teachpoint. Use the Place Custom Action to: • Delid labware at the Lid Hotel Station or the Vacuum Delid Station. • Press down labware to secure placement.
Last modified	The timestamp that shows when a teachpoint was changed.

Cycler tab



Command or option	Description
Insert teachpoints	Allows you to select the desired teachpoints from the existing teachpoints list.
Remove teachpoints	Removes the selected teachpoints from the Teachpoints list.
Pause after ___ cycles	Pauses the cycling after the specified number of cycle times.
All permutations	Runs the all-permutations cycling sequence.
Start/Pause	Starts the cycling.
Stop	Stops the cycling. The robot will stop after the current pick-and-place action.

Setup tab



Speed definitions

The following robot speeds are definable as a percentage of the factory-set maximum speed. The default percentage settings are as follows:

Speed	Default
Slow	20%
Medium	50%
Fast	80%

Gripper Settings (mm)

Command or option	Description
Open pos	The distance, in millimeters, between the grippers when they are open. The default values are 132 mm (landscape) and 95 mm (portrait).
Close target	The approximate distance, in millimeters, between the grippers when they are closed. The default values are 123.5 mm (landscape) and 81.5 mm (portrait). The Close target value is always used in conjunction with the Close tolerance value.

Command or option	Description
Close tolerance	The distance, in millimeters, the Close target is allowed to vary without causing an error. The default value is +/-3 mm.
Base clearance	The *z*-axis coordinate at which the bottom of the grippers touches the top of the base.
Finger height	The height of the grippers, measured from the midpoint of the gripper pads.

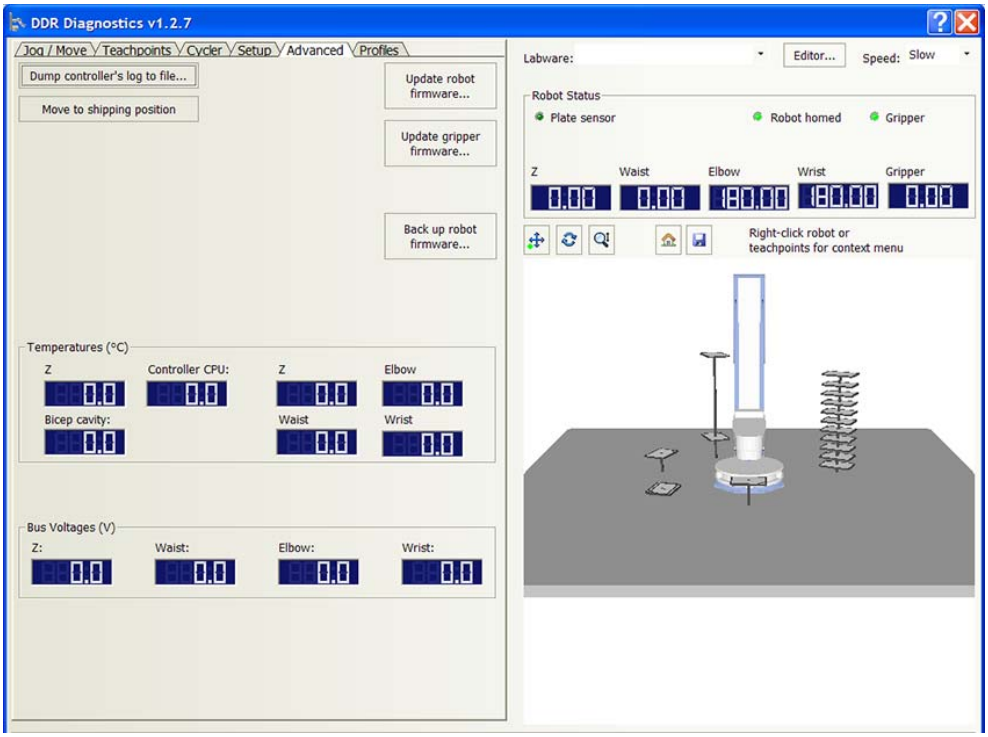
Table dimensions and Robot Position

Command or option	Description
W1/2	The width of the robot-attachment surface. W1 and W2 specify the lengths of the two segments of the width. The line that intercepts the end of W1 and the beginning of W2 runs through the center of the robot base.
D1/2	The depth of the robot-attachment surface. D1 and D2 specify the lengths of the two segments of the depth. The line that intercepts the end of D1 and the beginning of D2 runs through the center of the robot base.
Robot angle	The angle between the robot 0° position relative to the *D*-axis.

Commands

Command or option	Description
Save ALL advanced settings to file	Saves the current robot settings to a file.
Restore ALL advanced settings to file	Restores the robot settings from the selected file.

Advanced tab



Commands

Command or option	Description
Dump controller's log to file	Saves the robot controller log to a file.
Move to shipping position	Tucks the robot forearm and hand under the bicep to permit the installation of the shipping brace.
Update robot firmware	Backs up the existing robot firmware, and then updates, restores, or installs the selected firmware. **Caution:** If you have robot firmware version 1.1 or earlier, contact Automation Solutions Technical Support before starting the update procedure.
Update gripper firmware	Updates the selected gripper firmware.
Back up robot firmware	Backs up the robot firmware.

Temperatures (°C)

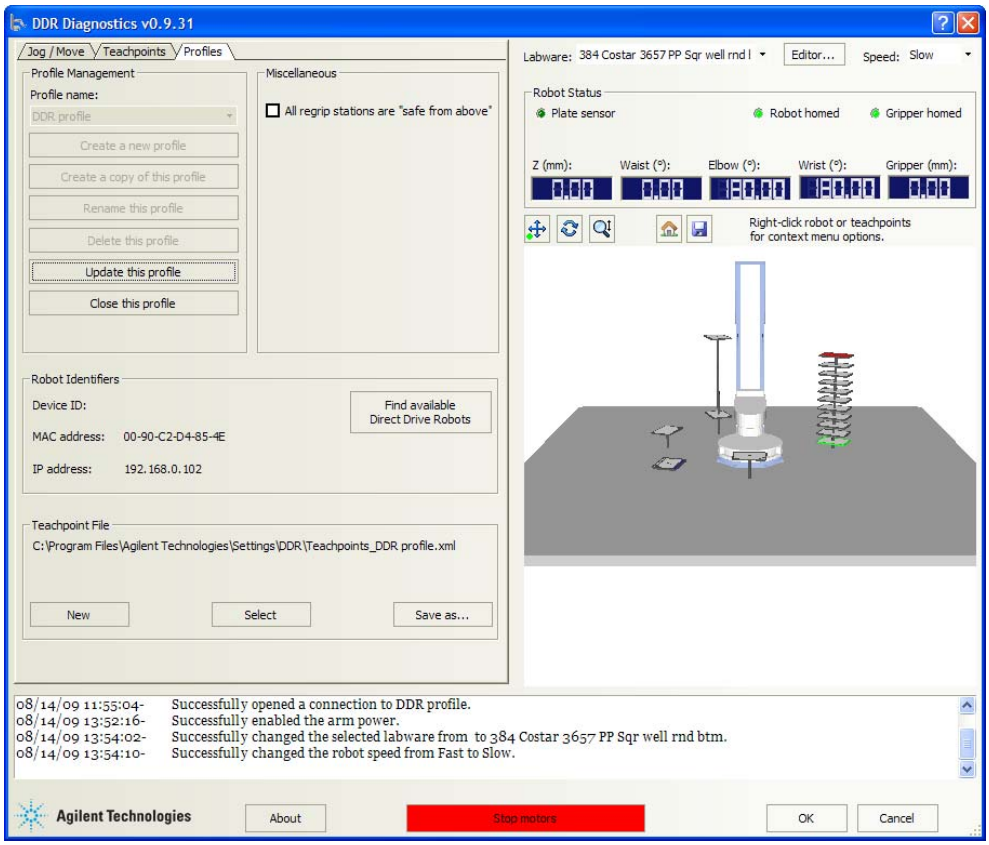
Component	Description
Z motor	The temperature of the *z*-axis motor.
Bicep cavity	The temperature of the bicep interior.

Component	Description
Controller CPU	The temperature of the contoller CPU.
Z amplifier	The temperature of the *z*-axis amplifier.
Waist	The temperature of the waist interior.
Elbow	The temperature within the elbow.
Wrist	The temperature inside the wrist.

Bus Voltages (V)

Component	Description
Z motor	The voltage delivered to the *z*-axis motor.
Waist	The voltage delivered to the waist motor.
Elbow	The voltage delivered to the elbow motor.
Wrist	The voltage delivered to the wrist motor.

Profiles tab



Profile Management area

Selection or command	Description
Profile name	Displays the selected profile. Also allows you to select from the list of available profiles.
Create a new profile	Creates a new profile.
Create a copy of this profile	Creates a duplicate copy of the selected profile.
Rename this profile	Renames the selected profile.
Delete this profile	Deletes the selected profile.
Update this profile	Saves changes to the selected profile.
Initialize this profile	Initiates communication with the robot using the selected profile.

Robot Identifiers area

Display value or command	Description
Device ID	Displays the name of the robot. This name is displayed in the Discovered BioNet Devices dialog box.
MAC address	Displays the MAC address that identifies the robot. The address is displayed in the Discovered BioNet Devices dialog box.
IP address	Displays the IP address that uniquely identifies the robot. The address is displayed in the Discovered BioNet Devices dialog box.
Find available Direct Drive Robot	Opens the Discovered BioNet Devices dialog box so that you can locate and select the robot.

Teachpoint File area

Display value or command	Description
File path	Displays the location of the selected teachpoint file.
New	Allows you to create a new teachpoint file.
Select	Allows you to select an existing teachpoint file.
Save as	Allows you to change the teachpoint file name or storage location from the default. The default teachpoint file name is Teachpoints_<profilename>.xml, where <profilename> is the name of the profile. The software saves the file in the C:\VWorks Workspace folder.

Miscellaneous area

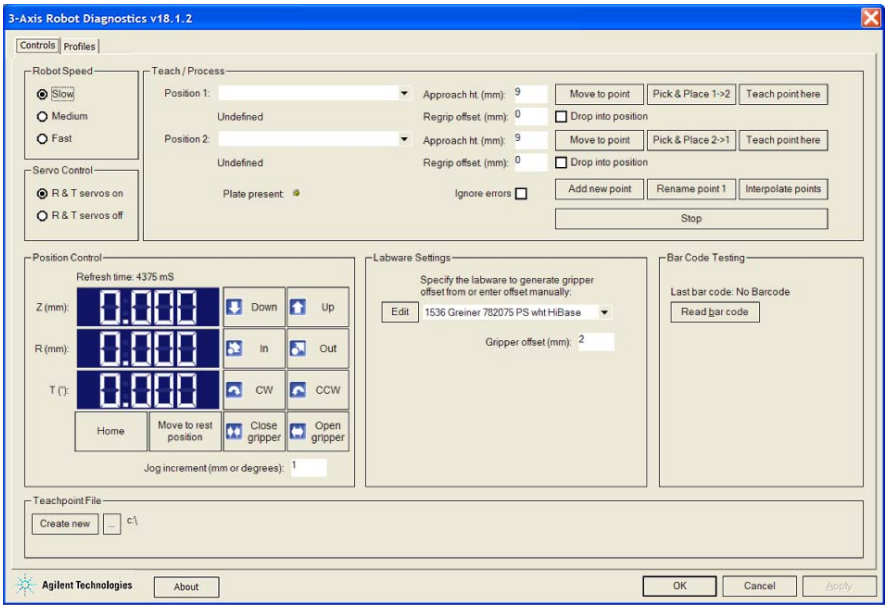
Option	Description
All regrip stations are safe from above	Indicates sufficient clearance at all regrip stations to permit the robot to rotate its wrist at the approach height. Use this option if one or more regrip stations will be used for changing labware orientation.

3-Axis Robot Diagnostics

This topic explains the menu commands, selections, options, and status information in the 3-Axis Robot Diagnostics dialog box. The topics are:

- "Controls tab" on page 375
- "Profiles tab" on page 379

Controls tab



Robot Speed area

Selection	Description
Slow	Sets the robot speed at Slow.
Medium	Sets the robot speed at Medium.
Fast	Sets the robot speed at Fast.

Servo control area

Selection	Description
R & T servos on	Turns on the robot *r*-axis and *t*-axis motors.
R & T servos off	Turns off the robot *r*-axis and *t*-axis motors.

Teach/Process area

Command or parameter	Description
Position 1	The teachpoint from which the robot will either pick up or place a labware.
Position 2	The teachpoint from which the robot will either place or pick up a labware.
Approach height (mm)	The height clearance (in millimeters) the robot must maintain above the teachpoint as it: • Moves towards the teachpoint to place labware. Use this setting if raised tabs or walls at the front of the teachpoint might obstruct the robot. • Moves away from the teachpoint after picking up labware. Use this setting if raised tabs or walls at the front of the teachpoint might obstruct the robot. • Moves to and from the teachpoint when the Drop into position option is selected. Use this setting if raised tabs or walls at the sides of the teachpoint do not obstruct but might be in contact with the robot grippers during labware pickup or placement. The contact does not damage the grippers or the platepad, stage, or shelf. You can reduce the approach height to prevent collision with shelves or other obstacles above the teachpoint.
Regrip offset (mm)	The height difference between the specified robot gripper offset and the actual allowable offset because of structural constraints at the teachpoint. Use this parameter if the teachpoint location has high walls or other structures that prevent the robot from holding the labware at the correct height during pickup.
Plate present	The indicator that shows whether a labware is present in the robot grippers.
Ignore errors	The option of ignoring errors when using the diagnostics software.
Move to point	Moves the robot to the selected teachpoint.

Command or parameter	Description
Pick & Place 1 -> 2	Picks up labware from Position 1 and places it at Position 2.
Teachpoint here	Sets the teachpoint at the current robot position.
Drop into position	The option of maintaining the specified approach height as robot picks up and places labware during a protocol run. Use this option if the teachpoint has raised tabs or walls at the sides that might obstruct the robot grippers.
Add new point	Allows you to create a new teachpoint in the teachpoint file.
Rename point 1	Allows you to rename the selected teachpoint in the Position 1 list.
Interpolate points	Opens a wizard that allows the software to set multiple teachpoints between two specified teachpoints.
Stop	Stops the robot.

Position Control area

Command or display value	Description
Refresh time	The length of time it takes for the software to receive the positional coordinates from the robot.
Z (mm)	The current *z*-axis coordinate relative to the home position.
R (mm)	The current *r*-axis coordinate relative to the home position.
T (°)	The current *t*-axis coordinate relative to the home position.
Home	Sends the robot to the factory-defined home position for each axis of motion. The homing process recalibrates the robot position along each axis.
Move to rest position	Sends the robot directly to the factory-defined home position without recalibrating each axis of motion. (Resting the robot is faster than homing the robot.)
Down	Jogs the robot down from the current position by the specified *z*-axis increment.
Up	Jogs the robot up from the current position by the specified *z*-axis increment.

Command or display value	Description
In	Jogs the robot toward its home position by the specified *r*-axis increment.
Out	Jogs the robot away from its home position by the specified *r*-axis increment.
CW	Jogs the robot clockwise from the current position by the specified *t*-axis increment.
CCW	Jogs the robot counterclockwise from the current position by the specified *t*-axis increment.
Close gripper	Closes the robot grippers by the specified grip increment.
Open gripper	Opens the robot grippers by the specified grip increment.
Jog increment (mm or degrees)	The distance, in millimeters or in degrees, the robot moves when you click a jog direction command.

Labware Settings area

Command or parameter	Description
Edit	Allows you to edit the selected labware definition.
Labware list	The list of labware definitions.
Gripper offset (mm)	The height at which the robot should grip the labware. Note: The setting is temporary and is used only during the current diagnostic session. To save the new value for the labware, use the Labware Editor.

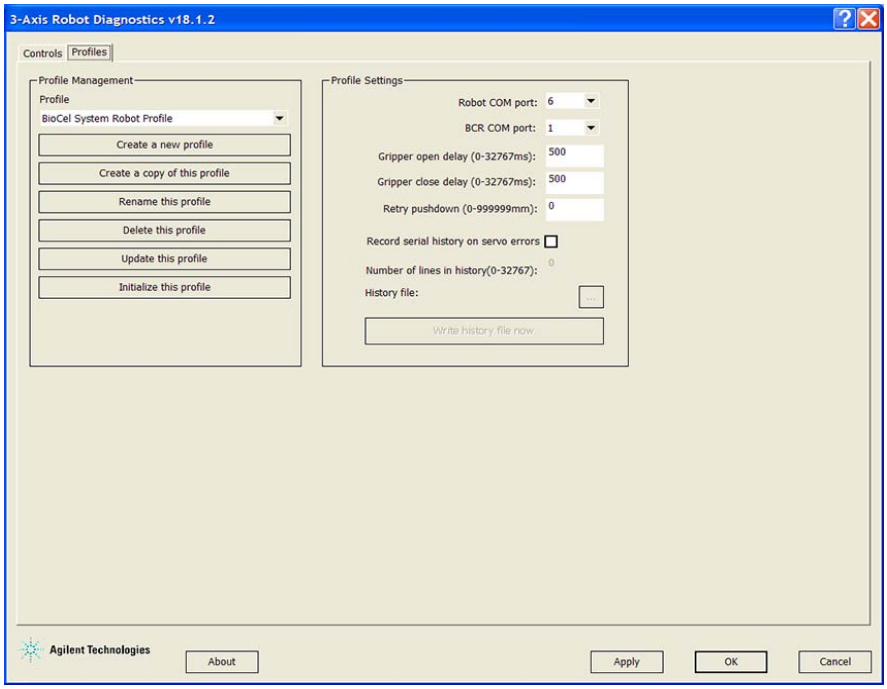
Barcode Testing area

Command	Description
Read barcode	Uses the barcode reader under the robot gripper to scan the labware barcode.

Teachpoint File area

Selection	Description
Create New	Allows you to create a new teachpoint file.
Browse	Allows you to open an existing teachpoint file on the computer.

Profiles tab



Profile Management area

Selection or command	Description
Profile	The list of profiles.
Create a new profile	Creates a new profile.
Create a copy of this profile	Creates a duplicate copy of the selected profile.
Rename this profile	Renames the selected profile.
Delete this profile	Deletes the selected profile.
Update this profile	Saves changes to the selected profile.
Initialize this profile	Initiates communication with the robot using the selected profile.

Profile Settings area

Selection or command	Description
Robot COM port	The serial port that connects the controlling computer to the robot.
BCR COM port	The serial port that connects the robot barcode reader to the controlling computer.

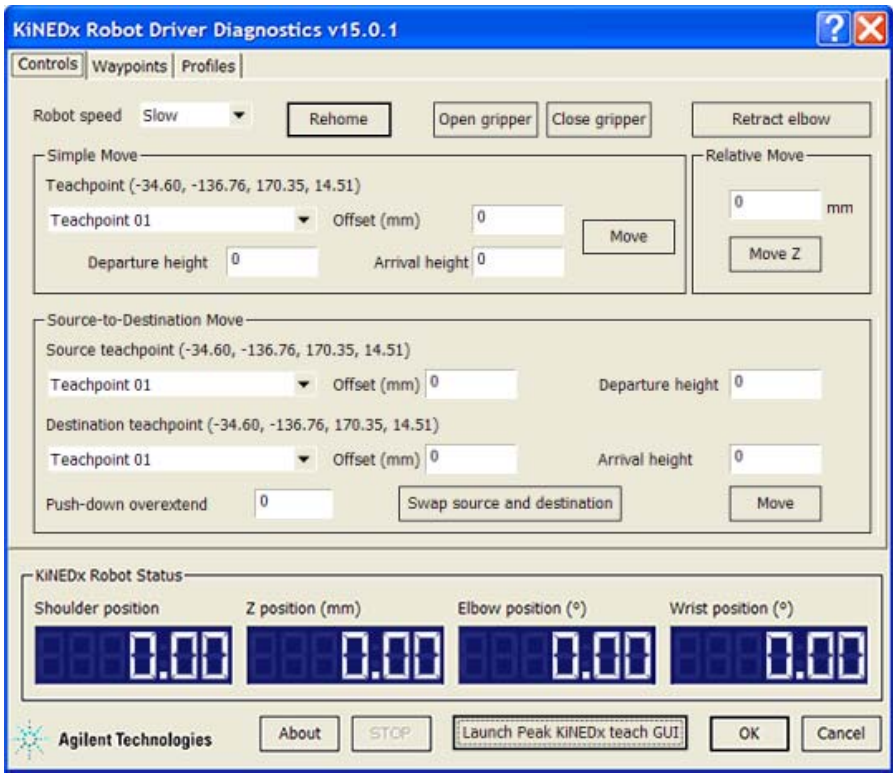
Selection or command	Description
Gripper open delay (ms)	The length of time, in milliseconds, that the robot waits after the grippers start to open. An optimum value allows the robot to fully release the labware before moving to the next destination. A lower-than-optimum value causes the robot to drag the labware from its current location before releasing it at an unintended location.
Gripper close delay (ms)	The length of time, in milliseconds, that the robot waits after the grippers start to close. An optimum value allows the robot to pick up the labware at the correct height before moving to the next destination. A lower-than-optimum value causes the robot to hold the labware higher than the specified height.
Retry pushdown (mm)	The distance, in millimeters, that the robot will push down on a labware after the absence of vacuum is detected at a vacuum filtration station, vacuum platepad, and vacuum shelf. The pressing down on the labware against the station, platepad, or shelf can help ensure a vacuum seal.
Record serial history on servo errors	The option that enables the software to record the robot communication messages to a log file when a servo error occurs. The log file can be used for troubleshooting the system.
Max lines in history	The maximum number of lines to keep in the history file.
Path to history file	The folder in which the history file is stored.
Test Dump History Now	The command that writes data to the history file.

KiNEDx Robot Driver Diagnostics

This topic explains the menu commands, selections, options, and status information in the KiNEDx Robot Diagnostics dialog box. The topics are:

- "Controls tab" on page 381
- "Waypoints tab" on page 384
- "Profiles tab" on page 385

Controls tab



Robot speed and command buttons

Selection or command	Description
Robot speed	The speed at which the KiNEDx Robot moves.
Rehome	Moves the robot to its home position.
Open gripper	Opens the robot gripper.
Closer gripper	Closes the robot gripper.
Retract elbow	Retracts the robot arm to ensure a minimal footprint.
About	Displays the software version number.

Selection or command	Description
STOP	Stops the robot.
Launch Peak KiNEDx teach GUI	Opens the KiNEDx Robot Teach Pendant dialog box.

Simple Move area

Parameter or command	Description
Teachpoint	The list of teachpoints in the teachpoint file.
Departure height	The height clearance, in millimeters, that the robot must maintain above the teachpoint as it moves away from the teachpoint.
Arrival height	The height clearance, in millimeters, that the robot must maintain above the teachpoint as it moves toward it.
Offset	The height at which the robot gripper holds the labware. Always set Offset at 0.
Move	Moves the robot to the selected teachpoint.

Relative Move area

Parameter or command	Description
mm	The vertical distance, in millimeters, to move the robot from its current *z*-axis position.
Move Z	Moves the robot by the specified distance along the *z*-axis.

Source-to-Destination Move area

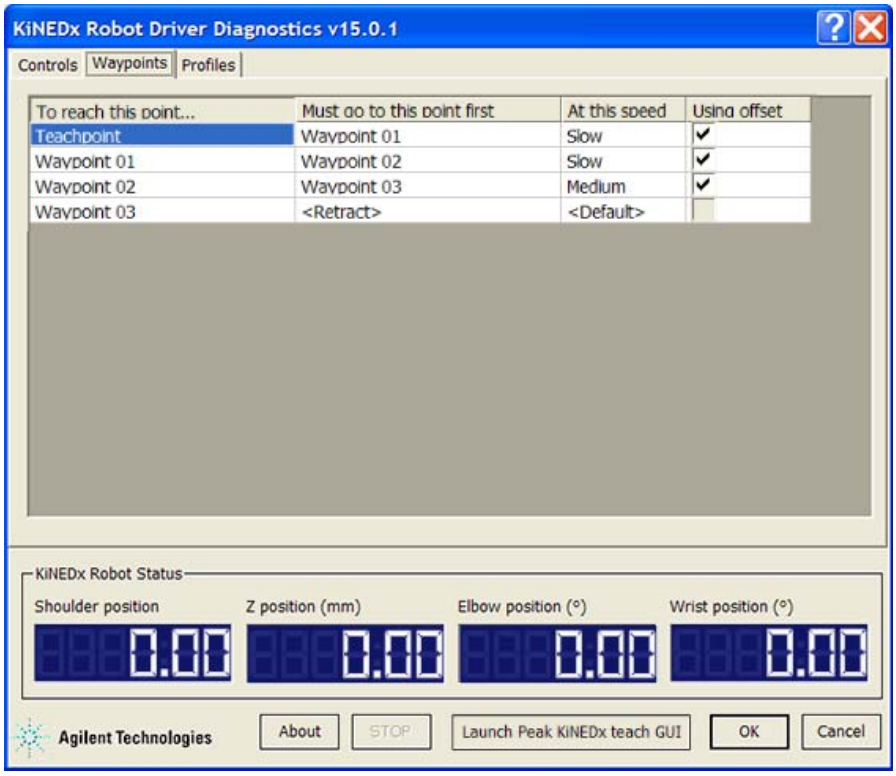
Parameter or command	Description
Source teachpoint	The teachpoint from which the robot will pick up labware.
Offset	The height at which the robot gripper holds the labware at the source teachpoint. Always set Offset at 0.
Departure height	The height clearance, in millimeters, that the robot must maintain above the teachpoint as it moves away from the teachpoint.

Parameter or command	Description
Destination teachpoint	The teachpoint at which the robot will place labware.
Offset	The height at which the robot gripper holds the labware at the destination teachpoint. Always set Offset at 0.
Arrival height	The height clearance, in millimeters, that the robot must maintain above the teachpoint as it moves toward it.
Push-down overextend	The additional *z*-axis distance, in millimeters, that the robot moves down past the teachpoint to secure the placement of the labware. Set Pushdown overextended at 0 unless it is a vacuum station that requires the slight pushdown.
Swap source and destination	Exchanges the source and destination teachpoints (the source becomes the destination, the destination becomes the source).
Move	Moves the robot from the selected source teachpoint to the selected destination teachpoint.

KiNEDx Robot Status area

Status	Description
Shoulder position	The coordinate that describes its current shoulder position.
Z position (mm)	The coordinate that describes its current *z*-axis position.
Elbow position (°)	The coordinate that describes its current elbow position.
Wrist position (°)	The coordinate that describes its current wrist position.

Waypoints tab



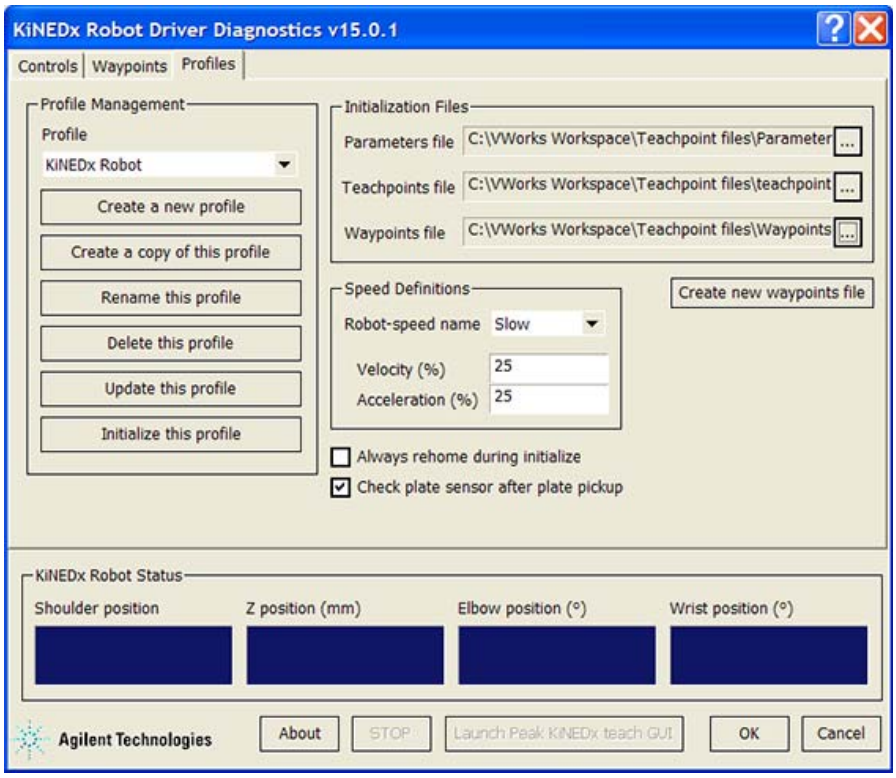
Waypoints table

Column	Description
To reach this point	The name of the teachpoint or waypoint to which the robot moves.
Must go to this point first	The name of the teachpoint or waypoint from which the robot moves to reach the teachpoint selected in the first column.
At this speed	The robot speed as it moves from the selected teachpoint in the second column to the selected teachpoint in the first column.
Using offset	The option to have the robot use the device approach height specified in the device file. Doing so allows the robot to approach the teachpoint at the correct clearance height. The check box is not available for terminal waypoints (points closest to the home position).

KiNEDx Robot Status area

Status	Description
Shoulder position	The coordinate that describes its current shoulder position.
Z position (mm)	The coordinate that describes its current *z*-axis position.
Elbow position (°)	The coordinate that describes its current elbow position.
Wrist position (°)	The coordinate that describes its current wrist position.

Profiles tab



Profile Management area

Selection or command	Description
Profile	The list of profiles.
Create a new profile	Creates a new profile.
Create a copy of this profile	Creates a duplicate copy of the selected profile.

Selection or command	Description
Rename this profile	Renames the selected profile.
Delete this profile	Deletes the selected profile.
Update this profile	Saves changes to the selected profile.
Initialize this profile	Initiates communication with the robot using the selected profile.

Initialization Files area

Selection or command	Description
Parameters file	The file that contains the robot home coordinates and other data.
Teachpoints file	The file that contains the robot teachpoint data.
Waypoints file	The file that contains the robot waypoint data.
Create new waypoints file	Allows you to create a new waypoints file.

Speed Definitions area

Selection or parameter	Description
Robot-speed name	The three speeds at which the KiNEDx Robot will move: • Slow • Medium • Fast You can use the Velocity and Acceleration parameters to set each speed (Slow, Medium, and Fast) as a percentage of the factory-set maximum speed.
Velocity (%)	The percentage of factory-set maximum speed. By default: • Slow is set at 25%. • Medium is set at 50%. • Fast is set at 100%.

Selection or parameter	Description
Acceleration (%)	The percentage of factory-set maximum acceleration. By default: • Slow is set at 25%. • Medium is set at 50%. • Fast is set at 100%.

Options

Option	Description
Always rehome during initialize	The option to return the robot to its home position during each initialization process. *Note:* The robot will always rehome if power was disrupted since the last robot initialization process.
Check plate sensor after plate pickup	The option to verify whether the robot has picked up a labware.

KiNEDx Robot Status area

Status	Description
Shoulder position	The coordinate that describes its current shoulder position.
Z position (mm)	The coordinate that describes its current *z*-axis position.
Elbow position (°)	The coordinate that describes its current elbow position.
Wrist position (°)	The coordinate that describes its current wrist position.

Index

Numerics

3-Axis Robot
- adding in device file, *112*
- axes, *15*
- closing grippers, *233*
- described, *15*
- disabling and enabling motors, *231*
- editing teachpoints, *127*
- homing, *230*
- jog direction, *233*
- jogging, *232*
- moving to teachpoint, *124*
- placing labware at teachpoint, *125*
- profile, *113*, *119*
- resting, *230*
- setting teachpoints, *118*
- speed, selecting, *231*
- teaching jig, *120*
- teachpoint file, *118*
- teachpoints, defined, *117*
- turning off motors, *120*
- verifying teachpoints, *124*

3-Axis Robot Diagnostics, *25*, *229*, *379*

A

A1-well orientation, *62*, *63*, *75*
Acceleration parameter, *279*
accessories. *See* devices
air
- connections, *12*
- controlling flow, *351*
- filter, *13*
- leaks, *183*
- pressure, *184*
- pressure regulation, *12*, *13*
- requirements, *5*
- shutoff valve, *13*, *351*
- switch, *8*, *351*
- system, *351*
- turning off, *36*
- turning on, *35*

All regrip stations are safe from above option, *50*, *87*
Approach Distance parameter, *81*
Approach height parameter (3-Axis Robot), *122*
Approach Ht (no labware) parameter, *80*
Approach Ht (with labware) parameter, *80*
Approach Ht parameter (Direct Drive Robot), *80*
Arrival height parameter, *144*, *146*
automation control software, *2*, *24*, *35*, *36*
Automation Solutions devices, *23*

B

barcode readers
- adding in device file, *245*
- aligning, *248*
- auxiliary, *242*, *244*
- power supply, *20*
- testing, *248*
- using manually, *235*

BCR COM port parameter, *115*
BioCel I/O Interface
- adding in device file, *252*
- console, *18*
- profile, *253*

BioCel System
- components, *2*
- compressed air requirements, *5*
- described, *2*
- device integration, *23*
- devices, *242*
- electrical requirements, *5*
- laboratory requirements, *5*
- maintenance, *174*
- power panel, *7*
- preparing for a run, *152*
- recovering from emergency stop, *175*
- robots, *15*
- shutting down, *36*
- starting up, *32*

BioCel System robot
- adding in device file, *40*
- described, *15*
- setting up (3-Axis Robot), *112*
- setting up (Direct Drive Robot), *46*
- setting up (KiNEDx Robot), *130*

block diagrams, *347*
bottle library, *343*
bus voltage, Direct Drive Robot, *223*

C

cleanup procedure, *36*
Close command (Direct Drive Robot grippers), *218*
Close gripper command (3-Axis Robot), *234*
Close gripper command (KiNEDx Robot), *239*
communication hubs, *18*
components of system, *2*
compressed air
- pressure regulation, *12*
- requirements, *5*
- shutoff valve, *13*
- turning off, *36*
- turning on, *35*

computer, *2*
connecting to the device, *198*
described, *17*
monitor, *17*
monitor, adjusting angle of, *31*
switching monitor display, *31*
turning off, *36*
turning on, *33*
configuration file (Direct Drive Robot), *223*
context-sensitive help, *xi*
custom actions, *84*

D

DC power supply, *349*
DDR Diagnostics, *25*, *206*
Advanced tab, *222*, *223*, *225*, *226*, *227*
Cycler tab, *108*
log area, *228*
Profiles tab, *48*
Setup tab, *54*, *57*, *219*, *223*
Teachpoints tab, *62*
DDRFirmwareBackup_.zip, *227*
DDRFirmwareUpdate_x_x_x-.zip, *225*
DDRGripperx.x.sw, *225*, *227*
delidder air pressure regulator, *13*
Departure height parameter, *144*, *146*
description
3-Axis Robot, *15*
BioCel System, *2*
Direct Drive Robot, *15*
KiNEDx Robot, *16*
device files
adding devices, *40*
creating, *24*, *40*
defined, *39*
saving, *40*
device stacking shelves, *242*
devices, *154*, *243*
adding and removing docking table, *9*
adding to device file, *40*
Automation Solutions, *23*
barcode reader, auxiliary, *242*, *244*
communicating with, *42*, *47*, *113*, *131*
defined, *23*, *39*
deleting in software, *42*
initializing, *42*
integration in system, *23*
Labware MiniHub, *242*
Lid Hotel Station, *242*, *266*
Linear Translator, *242*, *272*
Microplate Conveyor, *242*, *285*
Microplate Exchanger, *242*
Microplate Shuttle and Rotator, *242*
Orbital Shaking Station, *242*, *309*
Phantom Robot, *243*, *315*
Plate Hotel, *243*, *319*
Plate Hub Carousel, *243*, *319*
platepad, *243*, *329*
profiles in, *47*, *113*, *131*
stacking shelves, *242*
third-party, *23*
turning off, *36*
turning on, *33*
Vacuum Delid Station, *243*, *332*
waste bin, *243*, *337*
Weigh Pad, *243*, *340*
diagnostics software
3-Axis Robot, *229*
described, *25*
Direct Drive Robot, *206*
KiNEDx Robot Driver, *237*
version number, *viii*
digital signal channels, *255*
dimensions, BioCel System, *5*
Direct Drive Robot
adding in device file, *46*
axes, *15*
bus voltage, *223*
closing grippers, *217*
custom actions, *84*
described, *15*
disabling and enabling motors, *210*, *211*
elbow, *15*
error messages, *189*
firmware installation, *226*
firmware update, *224*
firmware version, *225*
firmware, described, *224*
gripper firmware update, *224*
gripper firmware version, *225*
gripper firmware, described, *224*
homing grippers, *208*
homing robot, *207*
installing teaching jig, *72*
IP address, *49*
jog increments, *215*, *217*
jogging, *215*
joints, *15*
MAC address, *49*
mast, *15*
movements, *15*
moving to safe zone, *209*
moving to teachpoint, *90*
multiple robots in a system, *47*
opening grippers, *217*
orientation coordinates, *61*
orientation information, *61*
orientations, atypical, *77*

orientations, common, *75*
picking up labware from a teachpoint, *93*
placing labware at a teachpoint, *96*
profile, *47*, *48*, *51*
regrip stations, *78*
removing teaching jig, *73*
restoring existing firmware, *226*
specifying A1-well orientation, *75*
specifying labware orientation, *75*
specifying robot-arm orientation, *75*
speed, selecting, *211*
Teach Mode, *72*
teaching jig, *71*, *72*
teachpoint file, *50*, *69*
teachpoints (examples), *64*
teachpoints, creating, *74*
teachpoints, defined, *60*
teachpoints, editing, *102*
teachpoints, replacing, *104*
teachpoints, saving, *85*
teachpoints, setting using labware, *88*
teachpoints, setting using teaching jig, *70*
teachpoints, verifying, *90*
temperature, *222*
transferring labware between teachpoints, *98*
view, changing, *221*
waist, *15*
wrist, *15*
disabling robot motors (3-Axis Robot), *231*
disabling robot motors (Direct Drive Robot), *210*, *211*
disabling robot motors (KiNEDx Robot), *138*
Discovered BioNet Devices (Direct Drive Robot), *48*
docking tables
automated procedure, *158*
described, *9*
manual procedure, *161*, *163*
pendant for, *160*
QuickDock feature, *158*
windows for, *10*, *156*
doors, automating, *251*
Drop into position option, *122*
dry runs, described, *153*

E

Elbow coordinate, *84*
electrical requirements, *5*, *183*
EMERGENCY STOP
buttons, *9*, *33*, *175*
circuit, *349*
connections, *349*
light curtain, using, *172*
procedure, *171*
recovering from, *175*
enabling robot motors (3-Axis Robot), *231*
enabling robot motors (Direct Drive Robot), *210*, *211*
enclosure windows, *257*
errors
hardware, *183*
ignoring, *235*
messages, *189*
messages (3-Axis Robot), *198*
messages (Direct Drive Robot), *189*
plate-sensor, *182*
reporting, *203*, *204*
servo, *180*
software, *177*, *189*
teachpoint, *86*, *153*
Ethernet switch, *18*

F

filtration station, *353*
firmware, *226*
checking version (Direct Drive Robot), *225*
described (Direct Drive Robot), *224*
installing (Direct Drive Robot), *226*
updating (Direct Drive Robot), *224*
fuse, *9*, *183*, *349*

G

gas supply, turning on, *35*
Gripper close delay parameter, *115*
gripper firmware
checking version (Direct Drive Robot), *225*
described (Direct Drive Robot), *224*
update (Direct Drive Robot), *224*
Gripper offset parameter, *83*, *232*
Gripper open delay parameter, *115*
grippers
opening and closing (3-Axis Robot), *233*
opening and closing (Direct Drive Robot), *216*
opening and closing (KiNEDx Robot), *239*
opening and closing manually, *73*
guidelines for setting teachpoints, *63*, *71*

H

hardware
errors, *183*, *203*
Home command (3-Axis Robot), *230*
Home grippers command (Direct Drive Robot), *208*
Home robot command (Direct Drive Robot), *207*

I

incubator device properties, *277*
interlock
air shutoff valve, *13*
air system, *351*
safety, *7*, *10*, *34*, *166*, *176*
switch, *8*, *34*

IP address, Direct Drive Robot, *49*

J

job roles for readers of this guide, *viii*
jogging the robot (3-Axis Robot), *232*
jogging the robot (Direct Drive Robot), *215*
jogging the robot (KiNEDx Robot), *237*
Joint space selection, *214*

K

keyboard shelf, adjusting, *30*
KiNEDx Robot
  adding in device file, *130*
  arm, retracting, *239*
  axes, *16*
  described, *16*
  diagnostics software, *25*
  disabling and enabling motors, *237*
  disabling motors, *138*
  homing, *141*, *238*
  jogging, *237*
  movements, *16*
  moving labware between teachpoints, *145*
  moving to teachpoints, *143*
  moving to waypoints, *143*
  profile, *131*
  speed, selecting, *238*
  teaching jig, *137*, *139*
  teachpoints file, *136*
  teachpoints, defined, *135*
  teachpoints, editing, *149*
  teachpoints, setting, *137*
  teachpoints, verifying, *143*, *147*
  turning off motors, *138*
  waypoints file, *136*
  waypoints, defined, *135*
  waypoints, editing, *149*
KiNEDx Robot Driver Diagnostics, *25*, *136*, *237*, *381*
KiNEDx Robot Teach Pendant software, *138*, *237*
knowledge base, *x*

L

laboratory requirements, *5*
labware
  definition, *24*, *184*
  gripper offset adjustment, *121*
  landscape orientation, *61*
  loading in system, *169*
  loading into Plate Hotel, *170*
  loading into Plate Hub Carousel, *170*
  moving between teachpoints (KiNEDx Robot), *145*
  orientation (Direct Drive Robot), *61*, *63*, *75*
  orientation in system, *169*
  picking up from teachpoint (Direct Drive Robot), *93*
  placing at teachpoint (3-Axis Robot), *125*
  portrait orientation, *61*
  transferring between teachpoints (Direct Drive Robot), *98*
Labware MiniHub
  described, *242*
landscape labware orientation, *61*
left-arm orientation, *61*, *75*
Lid Hotel Station
  adding in device file, *267*
  described, *242*, *266*
  profiles, *269*
  setting up, *266*
  status, *271*
  storage bays, *267*, *268*
  teachpoints, setting, *270*
lid remover, *243*, *332*
Light Curtain, *10*, *172*, *177*
Linear Translator, *242*
  adding in device file, *273*
  changing the speed, *283*
  described, *272*
  homing the plate stage, *281*, *282*
  incubator device properties, *277*
  jogging the plate stage, *283*
  profiles, *277*
  teachpoints, setting, *280*
  teachpoints, verifying, *281*
  turning off the motors, *282*
  turning on the motors, *282*
Linear Translator Robot Driver Diagnostics, *281*, *294*
liquid-handling tubing, *174*

M

MAC address, Direct Drive Robot, *49*
main power, *349*
  switch, *9*, *32*
  turning off, *37*
  turning on, *32*
maintenance, *174*
manifold, air distribution, *351*
Max gripper offset parameter, *83*
Max lines in history option, *116*
Microplate Conveyor, *242*
  adding in device file, *286*
  checking the plate presence sensor, *299*
  described, *285*
  homing the plate stage, *294*, *295*
  moving the plate stage, *296*
  moving the rollers, *298*
  moving to robot access position, *297*
  parking the plate stage, *298*
  profiles, *291*
  rotating the plate stage, *296*

setting up third-party devices with, *290*
storage device properties, *290*
teachpoints, setting, *293*
teachpoints, verifying, *294*
turning off the motors, *295*
turning on the motors, *295*
Microplate Exchanger
described, *242*
Microplate Shuttle and Rotator, *242*
adding in device file, *302*
profiles, *306*
teachpoints, *307*
turning the platepad, *307*
Min gripper offset parameter, *83*
Move to rest position command (3-Axis Robot), *230*
Move to safe zone command (Direct Drive Robot), *210*
multi-color status lights, *19*

N

network cards, *17*

O

online help, *x*
Open command (Direct Drive Robot grippers), *218*
Open gripper command (3-Axis Robot), *234*
Open gripper command (KiNEDx Robot), *239*
Orbital Shaking Station, *242*, *309*
orientation coordinates, *61*
orientation information, *61*
A1 well, *62*
labware, *61*
robot arm, *61*

P

parameters file, *133*
Path to history file option, *116*
PDF guide, *x*
Phantom Robot, *243*
adding in software, *315*
described, *315*
physical dimensions, *5*
Pick Custom Action parameter, *84*
pinch valve, *353*
Place Custom Action parameter, *85*
Plate Hotel, *243*
adding in device file, *310*
described, *319*
loading, *170*
teachpoints, setting, *327*
Plate Hub Carousel, *243*
adding in device file, *321*
described, *319*
home position, setting, *326*
loading, *170*
profile, creating, *323*
teachpoints, setting, *327*
turning the carousel, *326*
Plate Hub Diagnostics, *325*
Plate present indicator, *234*
plate sensor errors, *182*, *220*, *234*
Plate sensor indicator, *220*
platepad, *243*
adding in device file, *329*
described, *329*
plugins
loading, *41*
storage location, *41*
plumbing, *21*
portrait labware orientation, *61*
Position Z coordinate, *84*
power
block diagram, *348*
connection, *14*, *183*
outage, recovering from, *179*
panel, *7*
switch, *32*
turning off, *36*, *37*
turning on, *32*
power panel door lock, *9*
pre-emergency stop current, *349*
pre-run checks, performing, *166*
pre-UPS current, *349*
profiles
creating, *48*, *113*, *119*, *131*
defined, *47*, *113*, *131*
described, *25*, *47*, *113*, *131*
initializing, *50*, *134*
managing, *51*, *116*, *134*
selecting, *41*
protocol runs
performing dry runs, *153*
power outage, *179*
resuming, *177*
setup guidelines, *154*
starting, *24*
stopping in emergency, *171*
Pump Modules, *21*
Pushdown overextended parameter, *146*

Q

QuickDock feature, *158*

R

R & T servos off and on option, *231*
Record serial history on servo errors option, *116*
recovering the system, *175*
Regrip offset parameter, *121*
regrip stations

described, *77*
designating teachpoints as, *78*
regulators, *351*
Rehome command, *238*
Reload Plugins command, *41*
reserve tank, *353*
Reset button, *8*, *34*, *176*, *349*
resting the robot, *230*
restoring existing (Direct Drive Robot), *226*
Retrace to safe zone (Direct Drive Robot), *210*
Retract elbow command, *239*
Retry pushdown parameter, *115*
right-arm orientation, *61*, *75*
robot
adding in device file, *40*
arm, retracting (KiNEDx Robot), *239*
axes (3-Axis Robot), *15*
axes (Direct Drive Robot), *15*, *214*
axes (KiNEDx Robot), *16*
brakes, *350*
communication time (3-Axis Robot), *236*
homing (3-Axis Robot), *230*
homing (Direct Drive Robot), *207*
homing (KiNEDx Robot), *238*
jog increments (3-Axis Robot), *232*, *233*
jog increments (Direct Drive Robot), *215*, *217*
jogging (3-Axis Robot), *232*
jogging (Direct Drive Robot), *215*
jogging (KiNEDx Robot), *237*
opening and closing grippers (3-Axis Robot), *233*
opening and closing grippers (Direct Drive Robot), *216*
opening and closing grippers (KiNEDx Robot), *239*
power switch, *9*
recovering from servo errors, *180*
speed, selecting (3-Axis Robot), *231*
speed, selecting (Direct Drive Robot), *211*
speed, selecting (KiNEDx Robot), *238*
turning off, *37*
turning on, *32*, *33*
view, changing (Direct Drive Robot), *221*
Robot COM port parameter, *115*
robot gripper air pressure regulator, *13*
robot gripper pads, maintaining, *174*
robot grippers
closing (3-Axis Robot), *233*
closing (Direct Drive Robot), *216*, *217*
closing (KiNEDx Robot), *239*
homing (Direct Drive Robot), *208*
offset (3-Axis Robot), *232*
offset (Direct Drive Robot), *83*
opening (3-Axis Robot), *233*
opening (Direct Drive Robot), *216*, *217*
opening (KiNEDx Robot), *143*, *239*
robot motors
disabling and enabling (3-Axis Robot), *231*
disabling and enabling (Direct Drive Robot), *210*, *211*
disabling and enabling (KiNEDx Robot), *237*
robot pressure, *184*
robot-arm orientation, *61*, *63*, *75*
Rotator
adding in software, *302*
profiles, *306*
teachpoints, *307*
turning the plate stage, *307*
run
checks before starting, *166*
during power outage, *179*
monitoring, *19*
preparing for, *152*
resuming, *177*

S

safe zone, described, *208*
safety
EMERGENCY STOP, *171*
enclosure overhead windows, *10*
general information, *4*
Light Curtain, *10*, *172*, *177*
sliding windows, *10*
windows, *10*
windows on docking tables, *10*, *156*
safety interlock, *7*, *10*
bypassing, *257*, *349*
signals for, *251*, *257*
turning off, *176*
turning on, *34*, *166*
Scheduler Paused dialog box, *177*
serial hub, *18*
servo errors, recovering from, *180*
setup workflow
3-Axis Robot, *112*
Direct Drive Robot, *46*
KiNEDx Robot, *130*
system, *28*
Show robot position command, *79*
shutdown procedure, *36*
Shuttle
adding in software, *302*
profiles, *306*
teachpoints, *307*
turning the plate stage, *307*
software
automation control, *24*
described, *24*
errors, *177*, *189*, *198*, *203*
reporting errors, *203*
version number, *viii*, *203*
specifications, BioCel System, *5*

speed, selecting
3-Axis Robot, *231*
Direct Drive Robot, *211*
KiNEDx Robot, *238*
stack status lights, *19*
Stacker, *242*
stacking shelves for devices, *242*
startup procedure, *32*
status lights, *19*, *251*, *257*
Staubli Robot, *16*
storage device properties, *290*
storage, lids, *266*

T

Teach Mode command, *72*
teaching jig
3-Axis Robot, *120*
Direct Drive Robot, *71*, *72*, *73*
height adjustment, *121*
KiNEDx Robot, *137*, *139*
teachpoints
A1-well orientation (Direct Drive Robot), *75*
coordinates, changing, *84*
creating (Direct Drive Robot), *74*
creating a copy (Direct Drive Robot), *106*
defined (3-Axis Robot), *117*
defined (all robots), *25*
defined (Direct Drive Robot), *60*
defined (KiNEDx Robot), *135*
deleting (Direct Drive Robot), *106*
editing (3-Axis Robot), *127*
editing (Direct Drive Robot), *102*
editing (KiNEDx Robot), *147*, *149*
file (3-Axis Robot), *118*
file (Direct Drive Robot), *50*, *69*
file (KiNEDx Robot), *133*, *136*
labware orientation (Direct Drive Robot), *75*
moving to (3-Axis Robot), *124*
moving to (Direct Drive Robot), *90*
moving to (KiNEDx Robot), *143*
naming (Direct Drive Robot), *74*
naming (KiNEDx Robot), *140*
orientation coordinates, *61*
orientation information, *61*
picking up labware from (Direct Drive Robot), *93*
placing labware at (Direct Drive Robot), *96*
planning, *60*
profile references (general), *47*, *113*, *131*
renaming (3-Axis Robot), *128*
renaming (Direct Drive Robot), *106*
replacing (Direct Drive Robot), *104*
robot-arm orientation (Direct Drive Robot), *75*
saving, *85*
setting (3-Axis Robot), *118*
setting (Direct Drive Robot), *63*, *70*
setting (KiNEDx Robot), *137*
setting, using labware (Direct Drive Robot), *88*
storage location, *69*, *118*, *136*
verifying (3-Axis Robot), *124*
verifying (Direct Drive Robot), *90*
verifying (KiNEDx Robot), *143*
temperature, Direct Drive Robot, *222*
third-party devices, *23*
Tool space selection, *214*
trash door, *21*
troubleshooting, *25*, *173*, *205*
hardware errors, *183*
I/O channels, *263*
software errors, *189*

U

UPS, *21*
connections, *349*
turning off, *37*
turning on, *33*
using during power outage, *179*
user accounts, *24*
user guide
described, *viii*
related guides, *ix*

V

vacuum
creating, *351*
system, *353*
Vacuum Delid Station, *243*
adding to software, *333*
described, *332*
teachpoints, setting, *335*
Velocity parameter, *279*
version numbers, software, *viii*
Vertical Pipetting Station
brakes, *350*

W

Waist coordinate, *84*
waste bin, *243*
adding door to device file, *339*
adding to device file, *337*
described, *337*
replacing, *167*
waste bottle, *353*
waypoints
defined, *135*
editing, *149*
file, *133*, *136*
missing, *149*
moving to, *143*

naming, *140*
sequence, *142*
setting, *141*
verifying, *143*
Weigh Pad, *243*
adding to device file, *341*
bottle library, *343*
bottle status, *345*
calibrating, *344*
described, *340*
hub, *20*
profile, creating, *341*
Weigh Pad Diagnostics, *341*
Windows registry files, *47*, *113*, *131*
workflows
3-Axis Robot setup, *112*
barcode reader setup, *244*
Direct Drive Robot setup, *46*
KiNEDx Robot setup, *130*
Lid Hotel Station setup, *266*
Linear Translator setup, *272*
Microplate Conveyor setup, *286*
Plate Hotel setup, *309*
Plate Hub Carousel setup, *315*, *320*
preparing for a run, *152*
Rotator setup, *302*
Shuttle setup, *302*
system setup, *28*
teachpoints setup (3-Axis Robot), *118*
teachpoints setup (Direct Drive Robot), *70*
teachpoints setup (KiNEDx Robot), *137*
Vacuum Delid Station setup, *332*
Weigh Pad setup, *340*
Wrist coordinate, *84*

Z

Z-Brake Normal Override switch, *133*

Agilent Technologies

User Guide

G5500-90011

Revision 01, August 2010